BMJ Open

Play interventions for paediatric patients in hospital: a scoping review

Line Klingen Gjærde ,[1] Jane Hybschmann,[1] Daniel Dybdal,[1] Martha Krogh Topperzer,[1] Morten Arnborg Schrøder,[1] Jenny Louise Gibson,[2] Paul Ramchandani,[2] Elisabeth Ida Ginsberg,[1] Bent Ottesen,[1,3] Thomas Leth Frandsen,[1] Jette Led Sørensen[1,3]

To cite: Gjærde LK, Hybschmann J, Dybdal D, *et al*. Play interventions for paediatric patients in hospital: a scoping review. *BMJ Open* 2021;**11**:e051957. doi:10.1136/bmjopen-2021-051957

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2021-051957).

Received 03 April 2021
Accepted 13 July 2021

[1]Children's Hospital Copenhagen and Juliane Marie Centre, Rigshospitalet, Copenhagen, Denmark
[2]Centre for Research on Play in Education, Development & Learning, Faculty of Education, Cambridge University, Cambridge, UK
[3]Department of Clinical Medicine, Faculty of Health and Medical Sciences, University of Copenhagen, Copenhagen, Denmark

Correspondence to
Dr Line Klingen Gjærde; line.klingen.gjaerde.01@regionh.dk

ABSTRACT

Objective Play is a non-invasive, safe and inexpensive intervention that can help paediatric patients and their families manage difficult aspects of being ill or hospitalised. Although play has existed in hospitals for decades, research on hospital play interventions is scarce. This review aimed to categorise and synthesise the last 20 years of research on hospital play interventions.

Design Scoping review.

Data sources PubMed, CINAHL, CENTRAL, ERIC and PsycINFO (1 January 2000– 9 September 2020).

Study selection and data extraction We systematically searched for original peer-reviewed articles, written in English, on hospital play interventions in paediatric patients (0–18 years) in non-psychiatric settings. Two reviewers independently screened titles and abstracts, reviewed full text of relevant articles and extracted data. We thematically synthesised the data from the included studies, and a descriptive analysis, based on a developed framework, is presented.

Results Of the 297 included articles, 78% came from high-income countries and 56% were published within the last 5 years. Play interventions were carried out across all ages by various healthcare professionals. Play interventions served different roles within four clinical contexts: A) procedures and diagnostic tests, B) patient education, C) treatment and recovery and D) adaptation. Across these contexts, play interventions were generally facilitated and purpose-oriented and had positive reported effects on pain, stress, and anxiety.

Conclusions Play in hospitals is an emerging interdisciplinary research area with a significant potential benefit for child and family health. Future research should further describe principles for play in hospitals. High-quality studies investigating short-term and long-term effects are needed to guide when and how to best integrate play in hospitals.

Strengths and limitations of this study

- This review provides a comprehensive overview of 297 systematically collected original articles on play interventions in hospitals.
- The scoping review methodology allowed for assessing a wide variety of articles and identifying significant gaps in the literature.
- Drawing conclusions about implementation of play interventions remains difficult, as the existing literature is heterogenous with great variation in participants, comparator groups, study designs and outcomes.
- Grey literature, articles not written in English and unpublished studies were excluded.

INTRODUCTION

Play, long viewed as a means for children to cope with the challenges of hospitalisation,[1] is a way to reduce and prevent stress and anxiety in children.[2–4] Play is recognisable, safe and can be used to communicate complex information in an age-appropriate manner.[2] Furthermore, play is essential for healthy development, and adopting play interventions into the treatment and care of paediatric patients may reduce developmental regression.[2]

The WHO's standards of children's rights in hospital include the right to play. Recently, the WHO recommended that *all* doctors and nurses utilise play within treatment and care and that hospitals promote research on using play.[5]

Rapid turnover of hospitalised children, with few staying for longer periods, limits opportunities for playful relationships and comfortable familiarity with hospital playrooms.[6] Consequently, hospital play interventions are often individualised and treatment-oriented. In some countries play facilitated by specially trained staff for selected patients, rather than a normal, everyday activity.[6 7] Moreover, hospital resources, children's health status and treatment needs, expectations about illness and health behaviour influence the implementation of play interventions.[2 6 8] Attitudes towards children's integrity and adult participation in the child's play and the acceptance of playing with particular toys also affect the practices of play in hospitals.[9]

While many different traditions and practices exist in hospitals, most countries lack

formalised programmes on the use of play interventions. This might stem from a lack of knowledge on when, where and how to best practice play in the treatment and care of paediatric patients. Uniform implementation may be further challenged by continually changing conditions in healthcare.

Previous meta-analyses[10 11] and systematic reviews[12–21] have examined specific areas of play in hospitals, or specific play solutions for paediatric patients, but reviews on the general use of play in hospitals are limited. Existing reviews are further impaired by non-systematic literature searches and few included studies.[22 23] Therefore, this scoping review aims to categorise and synthesise the scientific literature on the use of hospital play interventions in the last 20 years to potentially inform, guide and encourage future efforts in using and evaluating play interventions in the care of paediatric patients.

METHODS

Search strategy and selection criteria

We conducted a scoping review, in accordance with Joanna Briggs Institute guidelines[24] and the underlying framework by Arksey and O'Malley.[25] This method is particularly relevant for presenting a broad overview of existing literature within an emerging scientific field, enabling rapid identification and mapping of key concepts and knowledge gaps.[25] We searched PubMed, CINAHL, CENTRAL, ERIC and PsycINFO for entries from 1 January 2000 to 7 June 2019 and updated it on 9 September 2020. Our search strategy followed the Peer Review of Electronic Search Strategies Statement[26] and was developed in collaboration with two information specialists. The full search terms are listed in online supplemental table 1. Our review protocol can be accessed on request.

We searched for peer-reviewed original studies available in English on play interventions within a hospital context in relation to various health-related and treatment-related outcomes among children and adolescents aged 0–18 years. Because formal consensus on the definition of play is lacking,[2 8] we included any intervention using a playful approach actively involving patients, but we excluded creative arts therapies such as music therapy. Play interventions may depend on age and developmental status. However, evidence-based age-specific subdivisions of play interventions are lacking in the existing literature. Therefore, we chose to search the broad paediatric population and subsequently describe the influence of age on choice and effect of the play interventions.

Hospital context was defined as somatic inpatient and outpatient settings and included rehabilitation centres and home treatment preceded by and/or followed up in an inpatient or outpatient setting. We excluded reviews, case reports, case series, studies with <5 participants and studies with a mean participant age >18 years or if <50% of participants were 0–18 years.

We imported search results into EndNote (V.X8, Clarivate Analytics, Philadelphia, Pennsylvania, USA) removing duplicates. Two independent reviewers (LKG, DD or JH) screened titles and abstracts using Rayyan systematic review software.[27] Final eligibility was assessed by reviewing the full text.

Data extraction

We developed a coding framework using a thematic synthesis approach inspired by Thomas and Harden.[28] Two reviewers (LKG, JH) extracted data on key study characteristics (publication year, country of origin, design, title, aim, number of participants, age, intervention, outcomes, tools for assessment, profession involved, disease category, procedure and type of play). To get an overview of which kind of resource settings the play intervention research originated from, we grouped the countries according to income using the World Bank's definition.[29] Uncertainties in data extraction were discussed with MS, MKT and JLS.

Based on extracted data, LKG and JH identified roles of the play interventions in included studies which led to the development of a broad coding framework. These thematic categories were discussed with the multidisciplinary coauthor group, comprising medical doctors with various specialties and competencies in medical education and management, an academic nurse and sociologist, a psychologist and researchers within public health and cultural studies. LKG and JH conducted a final coding based on the clinical contexts in which play interventions served different roles. Disagreements were solved in consultation with MKT and/or JLS. Descriptive statistics were analysed using Excel (V.2016, Microsoft, Redmond, Washington, DC, USA) and R (V.4.0.1, R Foundation for Statistical Computing, Vienna, Austria). Our report follows the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews checklist.[30 31] As critical appraisal, which is optional in the scoping methodology, we summarised key characteristics such as study design, randomisation approach, number of centres involved, population size and comparator group to give an overall impression of the risks of bias. Within each of the thematic categories of the framework, we describe the reported general effects of the play interventions.

Patient and public involvement

No patients were involved in carrying out this scoping review.

RESULTS

Of 3711 articles, 297 were included in the final review (figure 1). Detailed information on the included studies can be found in online supplemental tables 2 and 3. Articles originated from high-income countries (78%), particularly the USA, or middle-income countries (22%) (figure 2A). Since 2000, the number of articles published annually has increased steadily (figure 2B).

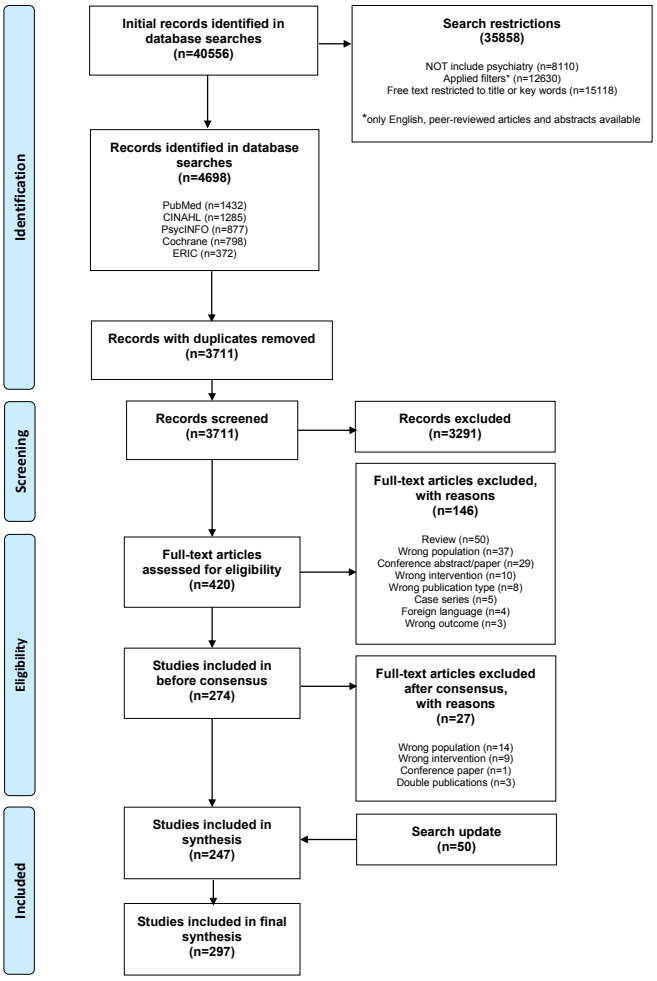

Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram of the study selection process.

The studies were generally small, with less than 25 participants in nearly one-third of them (figure 2C). Play interventions were used for all patients aged 0–18 years (figure 2D). We were unable to report age and developmental status-specific findings, because stratification based on these factors was limited. The interventions were mostly directed towards individual patients (94%) as opposed to groups (6%). Used within 13 disease categories (table 1), hospital play interventions were carried out by various professions (table 2).

Role of play within clinical contexts

Play interventions served different roles within four clinical contexts: (A) procedures and diagnostic tests, (B) patient education, (C) treatment and recovery and (D) adaptation (figure 3). Each context is summarised later, including context-specific study characteristics and examples (final coding agreement was 95%, 281/297 articles).

A) Play in procedures and diagnostic tests

In this context, play was used to either (1) distract the patient during a procedure (74 articles) or (2) prepare or support the patient before or during a procedure (55 articles). The primary purpose was to reduce anxiety, pain or distress (figure 4).

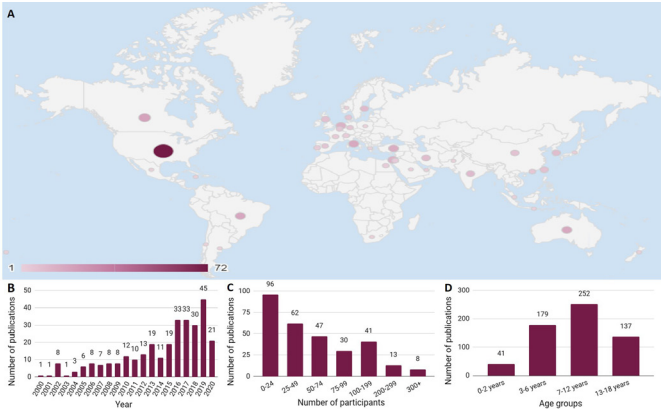

Figure 2 Summary characteristics of included studies. (A) Number of publications by county. (B) Number of publications per year.[a] (C) Number of participants. (D) Age range of participants. Studies that include one or more age groups are counted accordingly. [a]2020 publications included up to 9 September 2020.

Distraction

Play as a distraction was used for needle-related or other distressing procedures (table 3). Self-directed distractors (eg, handheld digital games, virtual reality (VR) games or toys such as kaleidoscopes) were more frequently used than facilitated distractions (where a parent, healthcare professional, or hospital clown blew soap bubbles or played with toys).

Playful distraction generally had positive effects, but when compared with non-play distractions, the effect was often similar.[32–34] Despite the frequent use of digital play distractors, their superiority over non-digital distractors was not evident, which a recent meta-analysis also concluded.[10] Furthermore, the comparator group and the definition of standard care varied greatly between the studies (table 3). Only one study examined whether the effect of distraction persisted in recurring procedures.[35]

Preparation and support

Playful preparation and support were used for surgeries or complex diagnostic tests, for example, imaging (table 3). This included digital media as part of structured preparational play (eg, VR tours in the operating room or online games) and creating a pretend journey with the child. Support before or during a procedure was used with younger patients, often by a hospital clown, through various playful approaches to help and encourage them by mirroring feelings or cheering them up.

Mostly positive effects were found. Three studies reported no effect of playful preparation on preoperative anxiety.[36–38] Despite generally large sample sizes, the heterogeneity of the studies limited comparisons (table 3), which is consistent with findings from prior reviews.[12–17]

Table 1 Participant characteristics in 297 included articles

Disease groups*	N (%)	
Cardiological diseases	**4 (1.3)**	
Congenital		3 (75.0)
Unspecified		1 (25.0)
Emergency medicine/care	**14 (4.7)**	
Musculo-skeletal trauma		1 (7.1)
Laceration repair		2 (14.3)
Unspecified		11 (78.6)
Endocrinological diseases	**16 (5.4)**	
Type 1 diabetes		6 (37.5)
Type 1 and 2 diabetes		1 (6.3)
Overweight/obesity†		9 (56.3)
Gastroenterological diseases	**2 (0.7)**	
Inflammatory bowel		1 (50.0)
Unspecified		1 (50.0)
Intensive care	**1 (0.3)**	
Unspecified		1 (100.0)
Nephrological diseases	**2 (0.7)**	
Daytime urinary incontinence		1 (50.0)
Unspecified		1 (50.0)
Neonatology	**8 (2.7)**	
Prematurity		8 (100)
Neurological diseases	**67 (22.6)**	
Acquired brain injury		2 (3.0)
Cerebral palsy		47 (70.1)
Other neuromotor and neuromuscular deficits‡		12 (17.9)
Chronic headache		1 (1.5)
Muscular dystrophy		4 (6.0)
Epilepsy		1 (1.5)
Oncological/haematological diseases	**41 (13.8)**	
Central nervous system tumour		6 (14.6)
Leukaemia		2 (4.9)
Osteosarcoma		1 (2.4)
Sickle cell disease		2 (4.9)
Various specified diseases§		14 (34.1)
Unspecified cancers		16 (39.0)
Ophthalmological diseases	**14 (4.7)**	
Amblyopia/strabismus		14 (100)
Allergic and respiratory diseases	**11 (3.7)**	
Allergy		1 (9.1)
Asthma		4 (36.4)
Cystic fibrosis		4 (36.4)
Unspecified respiratory diseases		2 (18.2)
Rheumatological diseases	**2 (0.7)**	
Juvenile idiopathic arthritis		2 (100)
Surgical diseases	**69 (23.2)**	
Appendicitis		1 (1.4)
Burns		18 (26.1)
Umbilical or inguinal hernia		1 (1.4)
Chronic wounds		1 (1.4)
Lower limb amputation		1 (1.4)
Meatal stenosis		1 (1.4)
Tooth extraction		2 (2.9)
Transplant receivers		1 (1.4)
Various specified surgical diseases		16 (23.2)
Unspecified surgical diseases		27 (39.1)
Other	**6 (2.1)**	
Down's syndrome		1 (16.7)
Immunisation		5 (83.3)
Various specified medical or surgical diseases	**10 (3.4)**	
Unspecified	**30 (10.1)**	
Total	**297 (100)**	

*Psychiatry literature was excluded during the selection process.
†Two studies also included obesity in Prader Willi syndrome.
‡Includes Erb's palsy, central gait disorders, congenital haemiplegia, degenerative ataxia, spina bifida, and other neuromotor and neuromuscular deficits that are unspecified in included studies.
§Mixed haematological and oncological diseases.

B) Play in patient education

In this context, play was used to teach patients about their disease and treatment (11 articles) to manage symptoms and promote medication adherence (figure 4).

Knowledge, skills and attitudes on disease and treatment

Play interventions were used to educate children as young as 5 years suffering from severe or chronic diseases eg, cancer, asthma or diabetes (table 3). Digital games were used in self-directed patient education. In one study,[39] a robot was used to quiz the patients.[39] Puppets were used to improvise real or fictitious situations to educate patients and facilitate a dialogue about disease management.[40 41]

All but one intervention[42] increased knowledge but affected symptoms to a lower degree. Two studies found that self-management awareness and the allure of being quizzed by a robot declined over time.[39 43] Despite the low number of studies using play in patient education, almost

Table 2 Professions* involved in the planning, execution and/or evaluation of the play intervention

Profession	N (%)	
Clinical staff	**226 (57.7)**	
Nurses (from various specialties, eg, oncology, anaesthetics (including students))		102 (26.0)
Medical doctors (including paediatricians, anaesthesiologists, ophthalmologists, allergists, rheumatologists, radiologists)		55 (14.0)
Psychologists		17 (4.3)
Paediatric dentists		2 (0.5)
Unspecified health professionals (including research teams)		50 (12.8)
Creative or play professions	**42 (12.5)**	
Hospital clowns		21 (5.3)
Child life specialists		17 (4.3)
Play specialists (including play therapists, play coordinators)		6 (1.5)
Music therapists		3 (0.8)
Game designers		2 (0.5)
Pet teams		2 (0.5)
Dance artists		1 (0.3)
Rehabilitation or training professions	**85 (21.5)**	
Physiotherapists (including students and physical education teachers)		68 (17.2)
Occupational therapists (including students)		13 (3.3)
Sport instructors		4 (1.1)
Other professions	**24 (6.1)**	
Other health professionals (including dieticians, porters, hospital teachers, speech therapists)		9 (2.3)
Teachers		3 (0.8)
Social workers		4 (1.0)
Not reported	**8 (2.2)**	
Total	**395 (100)**	

*More than one profession can be involved in an intervention.

half of the included articles reported findings from large multicentre studies (table 3).

There was generally a lack of studies that conducted a long follow-up on interventions that both increase knowledge and improve symptoms, which prior reviews also noted.[11 18 19]

C) Play as treatment and recovery

In this context, play interventions were used either (1) to replace or supplement medical or surgical treatment (24 articles) or (2) as rehabilitation or exercise (95 articles). The purpose of the studies varied substantially, reflecting the heterogeneity of studies within and between the two categories (figure 4).

Medical or surgical treatment

More than half of the studies used digital media, for example, video or tablet games, as a replacement for conventional patch treatment in children with amblyopia (table 3). Otherwise, VR, similar to that used to facilitate procedures, was used as a distraction to reduce acute pain or as a complementary treatment to inadequate pain management (eg, during sickle cell crisis). One study used a more advanced VR system employing biofeedback and positive images to treat chronic headache.[44]

The treatment interventions mainly had positive effects and could serve as an adjunct to standard treatment but were not necessarily better than conventional treatments.

Rehabilitation or exercise training

Play was used for rehabilitation in patients with chronic conditions such as cerebral palsy or in preterm children (table 3). Play was also used as an exercise for patients with, for example, obesity, cystic fibrosis or asthma. Digital games, the dominant types of play, were mainly investigated in small feasibility studies with no comparator groups.

The play interventions using digital media were generally feasible and safe, including complex VR games and robots. Play had the potential to increase adherence to programmes[45 46] and could serve as efficient supplemental in-home training.[47–49] Especially VR and video games showed promising results on strength and mobility,

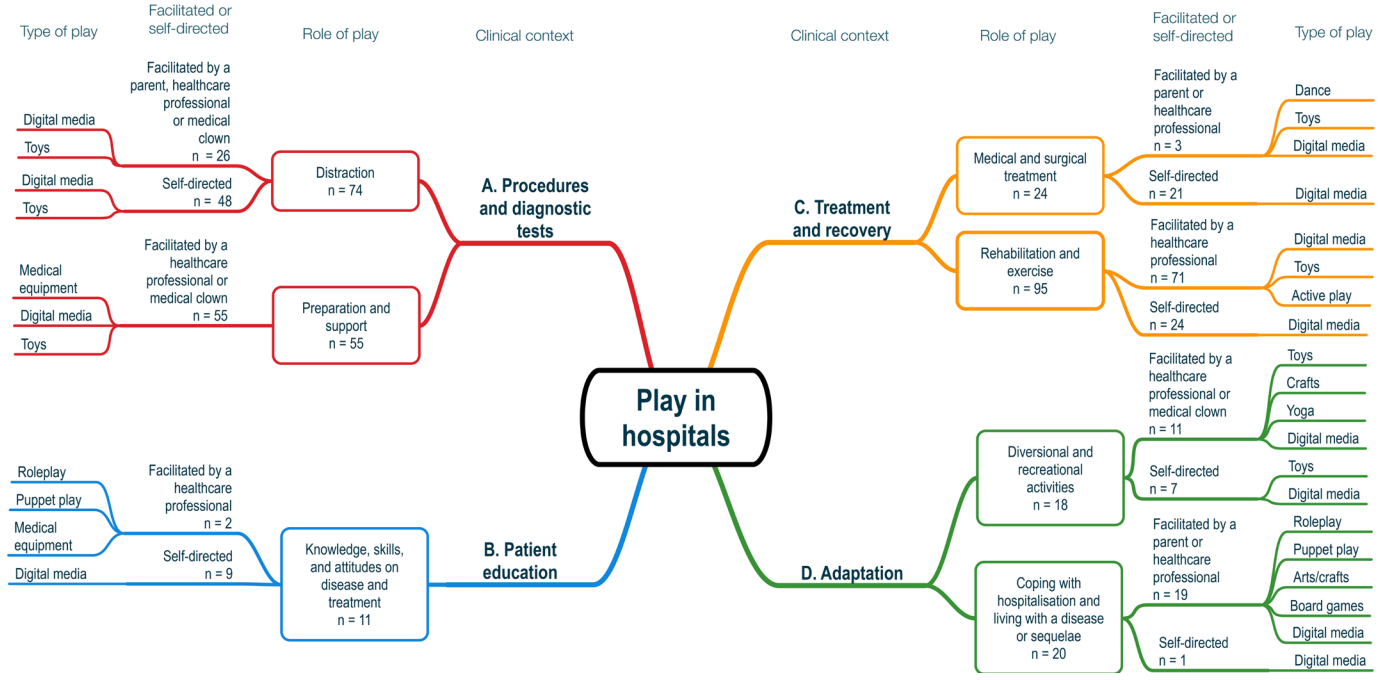

Figure 3 Conceptual model developed with a thematic approach mapping 'play in hospitals' by context, role of play, facilitated/self-directed and type of play.

which prior reviews also support.[20 21] When compared with conventional therapy, digital solutions were often, but not always,[50] better. Some studies also reported the risk of patients experiencing intervention fatigue.[39 46 51]

Study periods were mostly short (2–8 weeks), limiting the investigation of long-term effects, with only one study reporting effects of an intervention after 12 months.[47] Few disease groups were represented, potentially limiting applicability of the interventions to other disease groups.[52]

D) Play as adaptation

In this context, play interventions were characterised as (1) diversional or recreational activities (18 articles) or as (2) activities designed to help the child or adolescent cope with being hospitalised or ill (20 articles), often to reduce anxiety and stress or improve mood (figure 4).

Diversional and recreational activities

Most diversional or recreational play activities during hospitalisation occurred in patient rooms, playrooms, or waiting areas (table 3). There was predominantly unstructured play with toys and crafts, and play specialists, social robots, or hospital clowns visiting patient rooms.

Recreational or diversional play generally demonstrated positive effects. However, one study showed that stress was only reduced in patients >7 years,[53] while other studies reported that the effect of, for example, clown or social robot visits, waned over time.[54 55] Moreover, play was less efficient in reducing anxiety than other therapies, such as music and pet therapy.[56 57]

No studies investigated the long-term effects of unstructured play during hospitalisation on, for example, quality of life or general childhood development.

Coping with hospitalisation and living with a disease or sequalae

Play was used to help patients to better cope with hospitalisation, disease or sequelae, especially in relation to cancer (table 3). Activities such as creative play, digital social media platforms, and board games allowed expression of feelings about being ill and hospitalised. Play involving physical activity followed by an evaluation by a healthcare professional was also seen as improving coping. Primarily carried out in groups, interventions were facilitated by a healthcare professional, whose importance was also highlighted when digital social media was involved.

One-third of the studies were qualitative but generally lacked a theoretical framework. Quality of life and improved social skills were sparsely studied, just as long-term follow-up on diversional or recreational play was absent.

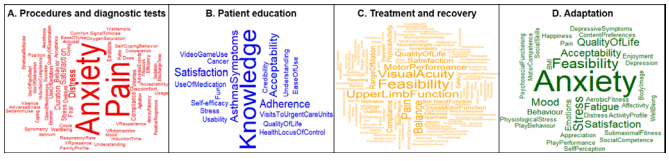

Figure 4 Word clouds on outcomes according to context of play.

DISCUSSION

We identified four clinical contexts where play had distinct roles: A) procedures and diagnostic tests, where play as distraction, preparation and support was used to alleviate pain, stress and anxiety; B) patient education, where play was used as age-appropriate communication

Table 3 Characteristics of study designs and comparator groups according to clinical context

Play in hospitals

	A. Procedures and diagnostic tests		B. Patient education	C. Treatment and recovery		D. Adaptation	
	Distraction	**Preparation and support**	**Knowledge, skills and attitudes on disease and treatment**	**Medical and surgical treatment**	**Rehabilitation and exercise***	**Diversional and recreational activities**	**Coping with hospitalisation and living with a disease or sequelae**
Study characteristics							
Median population size, (IQR)	58 (62.0)	80 (59.0)	70 (103.5)	59 (68.8)	20 (21.0)	60 (84.0)	28 (16.3)
Number of studies, N (%)	**74 (100%)**	**55 (100%)**	**11 (100%)**	**24 (100%)**	**95 (100%)**	**18 (100%)**	**20 (100%)**
Of these:							
Multicentre studies, n (%)	3 (4.1%)	2 (3.6%)	5† (45.5%)	5 (20.8%)	7 (7.4%)	0 (0.0%)	3 (15.0%)
Pilot studies, n (%)	12 (16.2)	3 (5.5%)	4 (36.4%)	5 (20.8%)	41 (44.2%)	3 (16.7%)	7 (35.0%)
Study design							
Clinical studies using randomisation, n (%)	52 (70.3%)	36 (65.5%)	6 (54.5%)	14 (58.3%)	44 (46.3%)	5 (27.8%)	5 (25.0%)
Intervention studies with no comparator group, n (%)	8 (10.8%)	3 (5.5%)	3 (27.3%)	4 (16.7%)	30 (31.6%)	2 (11.1%)	5 (25.0%)
Non-randomised clinical studies, n (%)	2 (2.7%)	5 (9.1%)	0 (0.0)	4 (16.7%)	12 (12.6%)	5 (27.8%)	3 (15.0%)
Quasi-randomised clinical studies, n (%)	8 (10.8%)	6 (10.9%)	0 (0.0%)	2 (8.3%)	7 (7.4%)	3 (16.7%)	1 (5.0%)
Qualitative studies, n (%)	4 (5.4%)	0 (0.0%)	2 (18.2%)	0 (0.0%)	2 (2.1%)	3 (16.7%)	6 (30.0%)
Other study designs, n (%)‡	0 (0.0%)	5 (9.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Comparator group							
Standard care, n (%)	41 (55.4%)	38 (69.1%)	5 (45.5%)	14 (58.3%)	39 (41.1%)	8 (44.4%)	5 (25.0%)
Multiple interventions, n (%)§	18 (24.3%)	9 (16.4%)	0 (0.0%)	4 (16.7%)	4 (4.2%)	2 (11.1%)	1 (5.0%)
Other play intervention, n (%)	3 (4.1%)	1 (1.8%)	1 (9.1%)	1 (4.2%)	1 (1.1%)	0 (0.0%)	1 (5.0%)

Continued

Table 3 Continued

Play in hospitals							
	A. Procedures and diagnostic tests		**B. Patient education**	**C. Treatment and recovery**		D. Adaptation	
	Distraction	**Preparation and support**	**Knowledge, skills and attitudes on disease and treatment**	**Medical and surgical treatment**	**Rehabilitation and exercise***	**Diversional and recreational activities**	**Coping with hospitalisation and living with a disease or sequelae**
Non-play intervention, n (%)	0 (0.0%)	1 (1.8%)	0 (0.0%)	0 (0.0%)	10 (10.5%)	3 (16.7%)	2 (10.0%)
No comparator, n (%)	12 (16.2%)	6 (10.9%)	5 (45.5%)	4 (16.7%)	32 (33.7%)	5 (27.8%)	11 (55.0%)
Healthy controls, n (%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (4.2%)	9 (9.5%)	0 (0.0%)	0 (0.0%)
Key characteristics within clinical context and role of play	**Type of procedure (%)**		**Disease category (%)**	**Symptom (%)**	**Disease category (%)**	**Intervention setting (%)**	**Target for coping strategies (%)**
	Needle related (61%) Wound care (14%) Surgery (12%) Physical examination (4%) Chemotherapy (3%) Mixed painful procedures (3%) Infusion (1%) Laceration repair (1%)	Surgery (62%) Needle related (11%) Radiotherapy (9%) MRI (5%) Burn wound dressing (5%) Cast removal (2%) Spirometry (2%) Ward rounds (2%) Laceration repair (2%)	Diabetes type 1+2 (55%) Cancer, various (27%) Asthma (18%)	Amblyopia (54%) Acute pain (29%) Chronic pain (4%) Incontinence (4%) Burn wound healing (4%) Obesogenic behaviour (4%)	Cerebral palsy (47%) Other neurological diseases (17%) Obesity (8%) Prematurity (8%) Respiratory diseases (6%) Surgical diseases (6%) Cancer (4%) Others (3%)	Playroom (67%) Patient room (33%)	Hospitalisation (40%) Living with disease or sequalae (60%)

*Rehabilitation versus exercise interventions: 83% rehabilitation versus 17% exercise.
†Five publications, four studies.
‡Audits and retrospective clinical studies.
§Multiple intervention groups compared with standard (and differences in standard care) and/or other play or non-play interventions.

and to increase understanding and motivation; C) treatment and recovery, where play could supplement and occasionally replace conventional treatment and D) adaptation, where play provided space to express difficulties about being hospitalised and supported healthy childhood development.

Prior opinion papers and non-systematic reviews have suggested various subdivisions and definitions of play in hospitals, but not in a rigorous manner.[2 23 58 59] It is generally recognised that play interventions can be used in the preparatory phase and as a distraction during medical procedures, and that play has a normalising effect.[23 58] The term therapeutic play is used inconsistently to describe play with medical equipment, play in preparation programmes,[17] and play therapy, similar to that used in child and adolescent psychiatry.[22] Other subcategories, for example, directed play, non-directed play and supporting play have also been used unevenly.[59] Our framework captures all of these subdivisions and contains a category for play as part of treatment and recovery, including rehabilitation. Previous reviews do not address this category, perhaps because rehabilitation and exercise are often outpatient activities and have only become a focus area more recently.[60]

Our framework may provide healthcare professionals and researchers with a tangible overview of the literature, while allowing play to retain its indefinable and ambiguous qualities. By summarising main characteristics, outcomes, general effects and potential pitfalls within the four clinical contexts, healthcare professionals and researchers are informed about play interventions similar to their own practices and research. Furthermore, this also informs about the breadth of possibilities and other approaches, which may encourage implementation of play interventions and inspire new ideas.

Our review primarily informs about facilitated and purpose-oriented play interventions in a clinical context. However, it is unknown whether this form of play positively impacts general health and development, which is a known benefit of unstructured play.[8] Identifying solutions that allow play to serve as a preventative and general-purpose activity in hospitals is crucial. Whether or not play interventions that support healthy childhood development in non-hospital environments are transferable directly to a hospital context is uncertain. Structural and cultural factors in hospitals challenge the opportunity for unstructured and free play, just as personal factors related to patients' illnesses and external factors such as an unfamiliar environment have an effect.[6]

Based on the current evidence, with very heterogenous and small studies, we were unable to draw conclusions on general aspects that could guide the implementation of future play interventions. Thus, additional high-quality research is needed to guide when, where, and what play to integrate into hospitals. Elaborating our proposed framework in a consensus-based study to further clarify principles for play interventions in hospitals, for example, the influence of age and development status on choice of play intervention, could serve to guide future research and play practices.[2] Studies are warranted to assess short-term and long-term effects of play integrated before, during and after procedures or treatments, and should address whether hospital play interventions can create an environment for children conducive to normal development. Importantly, input from paediatric patients will be central in informing concepts and future research in this regard.[61]

Furthermore, previous literature emphasised the significance of paediatric healthcare professionals who promote play,[3 62] but there is a lack of formal interprofessional training programmes available.[63 64] Our review shows that treatment and care by various healthcare professionals may benefit from the incorporation of play interventions. This necessitates high-quality research evaluating the short, sustained and long-term effects of play interventions in hospitals to help overcome current barriers, such as lack of training among clinical staff.[63]

Limitations

Despite our broad definition of play, our literature search may have introduced selection bias and missed relevant articles. Moreover, we did not include grey literature or review references in included articles to find additional articles, and we only searched for published studies, which may have introduced publication bias. By restricting our inclusion to studies in English, we may have introduced additional selection bias, which may undermine the global generalisability of our findings, especially in terms of the lack of studies from low-income countries. Finally, we excluded literature from child and adolescent psychiatry, thus limiting the application of results to somatic aspects of the hospital system.

CONCLUSIONS

Hospital play interventions have a significant potential benefit for patient and family health, and both treatment-oriented and unstructured play activities need to be prioritised. Our developed four-part operational categorisation of hospital play interventions can serve as the first step in enabling stringency in the field as well as inspire further exploration, and thereby support for the needed professionalisation and academisation of the growing research interest in play in hospitals.

Acknowledgements We thank information specialists Librarian Tove M. Svendsen, Medical Library at Rigshospitalet, Copenhagen, Denmark and Librarian Anders Larsen, The University Hospitals Centre for Health Research, UCSF, Copenhagen University Hospital Rigshospitalet, Copenhagen, Denmark, who assisted in generating the strategy for the literature searches in different databases.

Contributors LKG conceptualised and designed the study, designed the data collection instruments, collected data, carried out the initial analyses and interpreted data, drafted the initial manuscript, and reviewed and revised the manuscript. JH and DD designed the data collection instruments, collected data, carried out the initial analyses and interpreted the data, and critically reviewed the manuscript for important intellectual content. MKT supervised data collection, analysed and interpreted the data, and critically reviewed the manuscript for important intellectual content. MAS conceptualised and designed the study,

supervised data collection, interpreted the data and critically reviewed the manuscript for important intellectual content. EIG, JLG, PR, BO and TLF analysed and interpreted the data, and critically reviewed the manuscript for important intellectual content. JLS conceptualised and designed the study, coordinated and supervised data collection, interpreted the data and critically reviewed the manuscript for important intellectual content. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Map disclaimer The depiction of boundaries on this map does not imply the expression of any opinion whatsoever on the part of BMJ (or any member of its group) concerning the legal status of any country, territory, jurisdiction or area or of its authorities. This map is provided without any warranty of any kind, either express or implied.

Competing interests The Centre for Research on Play in Education, Development & Learning, Faculty of Education, University of Cambridge, Cambridge, UK is funded by the LEGO Foundation and a research grant from the National Institute for Health Research, UK.

Patient consent for publication Not required.

Ethics approval Not applicable as the review did not involve human or animal study subjects.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article or uploaded as supplementary information.

ORCID iD

Line Klingen Gjærde http://orcid.org/0000-0001-6894-1024

REFERENCES

1 Richards SS, Wolff E. The organization and function of play activities in the set-up of a pediatric department: a report of a three-year experiment. *Ment Hyg* 1940;24:229–37.
2 Nijhof SL, Vinkers CH, van Geelen SM, *et al*. Healthy play, better coping: the importance of play for the development of children in health and disease. *Neurosci Biobehav Rev* 2018;95:421–9.
3 Yogman M, Garner A, Hutchinson J, *et al*. The power of play: a pediatric role in enhancing development in young children. *Pediatrics* 2018;142:e20182058.
4 American Academy of Pediatrics Committee on Communications, American Academy of Pediatrics Committee on Psychosocial Aspects of Child and Family Health. The importance of play in promoting healthy child development and maintaining strong parent-child bonds. *Pediatrics* 2007;119:182–91.
5 WHO Regional Office for Europe. *Children's rights in hospital: Rapid-assessment checklists*. Copenhagen: World Health Organization, 2017.
6 Bolig R. Play in health care settings: a challenge for the 1990s. *Child Health Care* 1990;19:229–33.
7 Kleinberg S. Child life in the 1990s: changing roles, changing times. *Child Health Care* 1987;15:240–4.
8 Bolig R, Fernie DE, Klein EL. Unstructured play in hospital settings: an internal locus of control rationale. *Child Health Care* 1986;15:101–7.
9 Corlett S, Whitson A. Play and culture. *Paediatr Nurs* 1999;11:28–9.
10 Gates M, Hartling L, Shulhan-Kilroy J, *et al*. Digital technology distraction for acute pain in children: a meta-analysis. *Pediatrics* 2020;145:e20191139.
11 Charlier N, Zupancic N, Fieuws S, *et al*. Serious games for improving knowledge and self-management in young people with chronic conditions: a systematic review and meta-analysis. *J Am Med Inform Assoc* 2016;23:230–9.
12 Manyande A, Cyna AM, Yip P, *et al*. Non-pharmacological interventions for assisting the induction of anaesthesia in children. *Cochrane Database Syst Rev* 2015;7:CD006447.
13 McGuirt D. Alternatives to sedation and general anesthesia in pediatric magnetic resonance imaging: a literature review. *Radiol Technol* 2016;88:18–26.
14 Edwards AD, Arthurs OJ. Paediatric MRI under sedation: is it necessary? What is the evidence for the alternatives? *Pediatr Radiol* 2011;41:1353–64.
15 O'Connor M, Halkett GK. A systematic review of interventions to reduce psychological distress in pediatric patients receiving radiation therapy. *Patient Educ Couns* 2019;102:275–83.
16 Chow CHT, Van Lieshout RJ, Schmidt LA, *et al*. Systematic review: audiovisual interventions for reducing preoperative anxiety in children undergoing elective surgery. *J Pediatr Psychol* 2016;41:182–203.
17 He H-G, Zhu L, Chan SWC, *et al*. The effectiveness of therapeutic play intervention in reducing perioperative anxiety, negative behaviors, and postoperative pain in children undergoing elective surgery: a systematic review. *Pain Manag Nurs* 2015;16:425–39.
18 Drummond D, Monnier D, Tesnière A, *et al*. A systematic review of serious games in asthma education. *Pediatr Allergy Immunol* 2017;28:257–65.
19 Theng Y-L, Lee JWY, Patinadan PV, *et al*. The use of Videogames, Gamification, and virtual environments in the self-management of diabetes: a systematic review of evidence. *Games Health J* 2015;4:352–61.
20 Ravi DK, Kumar N, Singhi P. Effectiveness of virtual reality rehabilitation for children and adolescents with cerebral palsy: an updated evidence-based systematic review. *Physiotherapy* 2017;103:245–58.
21 Ravenek KE, Wolfe DL, Hitzig SL. A scoping review of video gaming in rehabilitation. *Disabil Rehabil Assist Technol* 2016;11:445–53.
22 Godino-Iáñez MJ, Martos-Cabrera MB, Suleiman-Martos N, *et al*. Play therapy as an intervention in hospitalized children: a systematic review. *Healthcare* 2020;8:239.
23 Koukourikos K, Tzeha L, Pantelidou P, *et al*. The importance of play during hospitalization of children. *Mater Sociomed* 2015;27:438–41.
24 Peters M, Godfrey C, McInerney P. *Chapter 11: Scoping reviews, Joanna Briggs Institute reviewer manual*. Adelaide, SA: The Joanna Briggs Institute, 2017.
25 Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol* 2005;8:19–32.
26 McGowan J, Sampson M, Salzwedel DM, *et al*. PRESS Peer Review of Electronic Search Strategies: 2015 Guideline Statement. *J Clin Epidemiol* 2016;75:40–6.
27 Ouzzani M, Hammady H, Fedorowicz Z, *et al*. Rayyan-a web and mobile APP for systematic reviews. *Syst Rev* 2016;5:210.
28 Thomas J, Harden A. Methods for the thematic synthesis of qualitative research in systematic reviews. *BMC Med Res Methodol* 2008;8:45.
29 World Bank. Country classification, world bank country and lending groups: world bank, 2021. Available: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups
30 Tricco AC, Lillie E, Zarin W, *et al*. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Ann Intern Med* 2018;169:467–73.
31 Moher D, Liberati A, Tetzlaff J, *et al*. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med* 2009;6:e1000097.
32 Gerçeker Gülçin Ö, Binay Şeyda, Bilsin E, *et al*. Effects of virtual reality and external cold and vibration on pain in 7- to 12-year-old children during phlebotomy: a randomized controlled trial. *J Perianesth Nurs* 2018;33:981–9.
33 Hedén L, VON Essen L, Ljungman G. Randomized interventions for needle procedures in children with cancer. *Eur J Cancer Care* 2009;18:358–63.
34 MacLaren JE, Cohen LL. A comparison of distraction strategies for venipuncture distress in children. *J Pediatr Psychol* 2005;30:387–96.
35 Ben-Pazi H, Cohen A, Kroyzer N, *et al*. Clown-care reduces pain in children with cerebral palsy undergoing recurrent botulinum toxin injections- a quasi-randomized controlled crossover study. *PLoS One* 2017;12:e0175028.

36 Carlsson RNE, Henningsson RN. Visiting the operating theatre before surgery did not reduce the anxiety in children and their attendant parent. *J Pediatr Nurs* 2018;38:e24–9.
37 Nasir M, Ahmed MJ, Arshad RM. Play distraction versus pharmacological treatment to reduce anxiety levels in children undergoing day surgery. *Medical Forum Monthly* 2018;29:82–5.
38 Eijlers R, Dierckx B, Staals LM, *et al*. Virtual reality exposure before elective day care surgery to reduce anxiety and pain in children: a randomised controlled trial. *Eur J Anaesthesiol* 2019;36:728–37.
39 Blanson Henkemans OA, Bierman BPB, Janssen J, *et al*. Using a robot to personalise health education for children with diabetes type 1: a pilot study. *Patient Educ Couns* 2013;92:174–81.
40 Pélicand J, Gagnayre R, Sandrin-Berthon B, *et al*. A therapeutic education programme for diabetic children: recreational, creative methods, and use of puppets. *Patient Educ Couns* 2006;60:152–63.
41 de Cássia Sparapani V, Liberatore RDR, Damião EBC, *et al*. Children with type 1 diabetes mellitus: self-management experiences in school. *J Sch Health* 2017;87:623–9.
42 Huss K, Winkelstein M, Nanda J, *et al*. Computer game for inner-city children does not improve asthma outcomes. *J Pediatr Health Care* 2003;17:72–8.
43 Shames RS, Sharek P, Mayer M, *et al*. Effectiveness of a multicomponent self-management program in at-risk, school-aged children with asthma. *Ann Allergy Asthma Immunol* 2004;92:611–8.
44 Shiri S, Feintuch U, Weiss N, *et al*. A virtual reality system combined with biofeedback for treating pediatric chronic headache--a pilot study. *Pain Med* 2013;14:621–7.
45 Adamo KB, Rutherford JA, Goldfield GS. Effects of interactive video game cycling on overweight and obese adolescent health. *Appl Physiol Nutr Metab* 2010;35:805–15.
46 Brütsch K, Koenig A, Zimmerli L, *et al*. Virtual reality for enhancement of robot-assisted gait training in children with central gait disorders. *J Rehabil Med* 2011;43:493–9.
47 Del Corral T, Cebrià I Iranzo Maria Àngels, López-de-Uralde-Villanueva I, *et al*. Effectiveness of a home-based active video game programme in young cystic fibrosis patients. *Respiration* 2018;95:87–97.
48 Parry I, Painting L, Bagley A, *et al*. A pilot prospective randomized control trial comparing exercises using Videogame therapy to standard physical therapy: 6 months follow-up. *J Burn Care Res* 2015;36:534–44.
49 Sajan JE, John JA, Grace P, *et al*. Wii-based interactive video games as a supplement to conventional therapy for rehabilitation of children with cerebral palsy: a pilot, randomized controlled trial. *Dev Neurorehabil* 2017;20:361–7.
50 Heutinck L, Jansen M, van den Elzen Y, *et al*. Virtual reality computer gaming with dynamic arm support in boys with Duchenne muscular dystrophy. *J Neuromuscul Dis* 2018;5:359–72.
51 Hung J-W, Chang Y-J, Chou C-X, *et al*. Developing a suite of Motion-Controlled games for upper extremity training in children with cerebral palsy: a proof-of-concept study. *Games Health J* 2018;7:327–34.
52 Gatica-Rojas V, Méndez-Rebolledo G, Guzman-Muñoz E, *et al*. Does Nintendo Wii balance board improve standing balance? A randomized controlled trial in children with cerebral palsy. *Eur J Phys Rehabil Med* 2017;53:535–44.
53 Potasz C, De Varela MJV, De Carvalho LC, *et al*. Effect of play activities on hospitalized children's stress: a randomized clinical trial. *Scand J Occup Ther* 2013;20:71–9.
54 Logan DE, Breazeal C, Goodwin MS, *et al*. Social robots for hospitalized children. *Pediatrics* 2019;144:e20181511.
55 Pinquart M, Skolaude D, Zaplinski K, *et al*. Do clown visits improve psychological and sense of physical well-being of hospitalized pediatric patients? A randomized-controlled trial. *Klin Padiatr* 2011;223:74–8.
56 Hendon C, Bohon LM. Hospitalized children's mood differences during play and music therapy. *Child Care Health Dev* 2008;34:141–4.
57 Hinic K, Kowalski MO, Holtzman K, *et al*. The effect of a PET therapy and comparison intervention on anxiety in hospitalized children. *J Pediatr Nurs* 2019;46:55–61.
58 Jun-Tai N. Play in hospital. *Paediatr Child Health* 2008;18:233–7.
59 Williams NA, Ben Brik A, Petkus JM. Importance of play for young children facing illness and hospitalization: rationale, opportunities, and a case study illustration. *Early Child Development and Care* 2019:1–10.
60 Committee on Hospital Care and Child Life Council. Child life services. *Pediatrics* 2014;133:e1471–8.
61 Howard J. The power of play. *The Lancet* 2020;395:261–2.
62 Milteer RM, Ginsburg KR, *et al*, Council On Communications And Media. The importance of play in promoting healthy child development and maintaining strong parent-child bond: focus on children in poverty. *Pediatrics* 2012;129:e204–13.
63 Stenman K, Christofferson J, Alderfer MA, *et al*. Integrating play in trauma-informed care: multidisciplinary pediatric healthcare provider perspectives. *Psychol Serv* 2019;16:7–15.
64 Jepsen SL, Haahr A, Eg M, *et al*. Coping with the unfamiliar: how do children cope with hospitalization in relation to acute and/or critical illness? A qualitative metasynthesis. *J Child Health Care* 2019;23:534–50.

Supplemental Information

Supplemental Table 1. Search Strategy

PubMED

(((("Child"[MeSH Terms] OR "Infant"[MeSH Terms] OR "Adolescent"[MeSH Terms] OR "Minors"[MeSH Terms] OR "Child Health"[MeSH Terms] OR "child, hospitalized"[MeSH Terms] OR "Pediatrics"[MeSH Terms] OR "Adolescent Medicine"[MeSH Terms] OR "hospitals, pediatric"[MeSH Terms] OR "intensive care units, pediatric"[MeSH Terms] OR ("Child"[Title] OR "Child"[Other Term] OR "Infant"[Title] OR "Infant"[Other Term] OR "Adolescent"[Title] OR "Adolescent"[Other Term] OR "Minors"[Title] OR "Minors"[Other Term] OR "Child Health"[Title] OR "Child Health"[Other Term] OR ("Child"[Title] AND "Hospitalized"[Title]) OR "Hospitalized Child"[Title] OR "Hospitalized Child"[Other Term] OR "Pediatric"[Title] OR "Pediatrics"[Other Term] OR "Paediatric"[Title] OR "Paediatrics"[Other Term] OR "Adolescent Medicine"[Title] OR "Adolescent Medicine"[Other Term] OR "Pediatric Hospital"[Title] OR "Pediatric Hospital"[Other Term] OR "Paediatric Hospital"[Title] OR "Paediatric Hospital"[Other Term] OR "Pediatric Intensive Care Unit"[Title] OR "Pediatric Intensive Care Unit"[Other Term] OR "Paediatric Intensive Care Unit"[Title] OR "Paediatric Intensive Care Unit"[Other Term] OR "Newborn"[Title] OR "Newborn"[Other Term] OR "Youths"[Title] OR "Youths"[Other Term] OR "teen"[Title] OR "teen"[Other Term] OR "baby"[Title] OR "baby"[Other Term] OR "babies"[Title] OR "babies"[Other Term])) AND ("play and playthings"[MeSH Terms] OR "Virtual Reality"[MeSH Terms] OR "play Therapy"[MeSH Terms] OR ("Play"[Title] OR "Play"[Other Term] OR "child life"[Other Term] OR "Virtual Reality"[Title] OR "Virtual Reality"[Other Term] OR ("Play"[Title] AND "Therapy"[Title]) OR "play Therapy"[Title] OR "play Therapy"[Other Term] OR "child life"[Title] OR "Toy"[Title] OR "Toy"[Other Term] OR "Clown"[Title] OR "Clown"[Other Term] OR "game"[Title] OR "game"[Other Term])) AND ("treatment outcome"[MeSH Terms] OR "patient outcome assessment"[MeSH Terms] OR "Patient Compliance"[MeSH Terms] OR "Quality of life"[MeSH Terms] OR "Pain"[MeSH Terms] OR "pain perception"[MeSH Terms] OR "pain management"[MeSH Terms] OR "pain measurement"[MeSH Terms] OR "pain, postoperative"[MeSH Terms] OR "stress, psychological"[MeSH Terms] OR "Anxiety"[MeSH Terms] OR "fear"[MeSH Terms] OR "adaptation, psychological"[MeSH Terms] OR "Health Behavior"[MeSH Terms] OR "Illness Behavior"[MeSH Terms] OR "social skills"[MeSH Terms] OR "motor skills"[MeSH Terms] OR "cognition"[MeSH Terms] OR ("Outcome assessment"[Title] OR "Outcome assessment"[Other Term] OR "Patient Outcome"[Title] OR "Patient Outcome"[Other Term] OR ("Patient"[Title] AND "Compliance"[Title]) OR "Patient Compliance"[Title] OR "Patient Compliance"[Other Term] OR ("Patient"[Title] AND "Adherence"[Title]) OR "Patient Adherence"[Title] OR "Patient Adherence"[Other Term] OR ("Treatment"[Title] AND "Compliance"[Title]) OR "Treatment Compliance"[Title] OR "Treatment Compliance"[Other Term] OR ("Treatment"[Title] AND "Adherence"[Title]) OR "Treatment Adherence"[Title] OR "Treatment Adherence"[Other Term] OR ("Medication"[Title] AND "Compliance"[Title]) OR "Medication Compliance"[Title] OR "Medication Compliance"[Other Term] OR ("Medication"[Title] AND "Adherence"[Title]) OR "Medication Adherence"[Title] OR "Medication Adherence"[Other Term] OR "Quality of life"[Title] OR "Quality of life"[Other Term] OR "Life quality"[Title] OR "Life quality"[Other Term] OR "Pain"[Title] OR "Pain"[Other Term] OR "Psychological stress"[Title] OR "Psychological stress"[Other Term] OR "Anxiety"[Title] OR "Anxiety"[Other Term] OR "fear"[Title] OR "fear"[Other Term] OR "Psychological adaptation"[Title] OR "Psychological adaptation"[Other Term] OR "Health Behavior"[Title] OR "Health Behavior"[Other Term] OR "Illness Behavior"[Title] OR "Illness Behavior"[Other Term] OR "motor skills"[Title] OR "motor skills"[Other Term] OR "social skills"[Title] OR "social skills"[Other Term] OR "emotional Skills"[Title] OR "emotional Skills"[Other Term] OR "cognitive skills"[Title] OR "cognitive skills"[Other Term])))) NOT ("psychiatry"[MeSH Terms] OR "mental disorders"[MeSH Terms] OR ("psychiatrie"[All Fields] OR "psychiatries"[All Fields] OR "psychiatry"[MeSH Terms] OR "psychiatry"[All Fields] OR "psychiatry s"[All Fields]) OR ("psychiatrical"[All Fields] OR "psychiatrically"[All Fields] OR "psychiatrics"[All Fields] OR "psychiatry"[MeSH Terms] OR "psychiatry"[All Fields] OR "psychiatric"[All Fields]) OR "Mental Disorder"[All Fields] OR "Mental illness"[All Fields])) AND ("journal article"[Publication Type] AND "hasabstract"[Text Word] AND 2000/01/01:2019/06/05[Date - Publication] AND "humans"[MeSH Terms] AND "English"[Language]) AND "journal article"[Publication Type] AND "hasabstract"[Text Word] AND 2000/01/01:2019/06/07[Date - Publication] AND "humans"[MeSH Terms] AND "English"[Language]

EBSCOhost (PsycINFO, CINAHL, ERIC)

S6: S4 NOT S5 Limiters - Published Date: 20000101-
S5: psychiatry OR mental disorders OR psychiatry OR mental disorders OR mental disorders OR mental illness OR psychiatric OR psychiatry OR psychiatry OR mental disorders
S4: S1 AND S2 AND S3
S3: KW "outcome assessment" OR KW "treatment outcome" OR KW "patient outcome" OR KW "patient compliance" OR KW "patient adherence" OR KW "treatment compliance" OR KW "treatment adherence" OR KW "medication compliance" OR KW "medication adherence" OR KW "quality of life" OR KW "life quality" OR KW pain OR KW "psychological stress" OR KW anxiety OR KW fear OR KW "psychological adaptation" OR KW "health behavior" OR KW "illness behavior" OR KW "motor skills" OR KW "social skills" OR KW "emotional skills" OR KW "cognitive skills" OR MA outcome assessment OR MA treatment outcome OR MA patient outcome assessment OR MA patient compliance OR MA quality of life OR MA pain OR MA pain perception OR MA pain management OR MA pain measurement OR MA pain, postoperative OR MA stress, psychological OR MA anxiety OR MA fear OR MA adaptation, psychological OR MA health behavior OR MA illness behavior OR MA social skills OR MA motor skills OR MA cognition OR DE treatment outcome OR DE compliance OR DE quality of life OR DE quality of life measures OR DE pain OR DE pain perception OR DE pain management OR DE pain measurement OR DE psychological stress OR DE anxiety OR DE anxiety management OR DE fear OR DE adaptive learning OR DE child behavior OR DE child attitude OR DE adolescent behavior OR DE adolescent attitude OR DE social skills OR DE motor skills OR DE cognition OR DE social skills training OR TI "psychological stress" OR TI anxiety OR TI fear OR TI "psychological adaptation" OR TI "health behavior" OR TI "illness behavior" OR TI "motor skills" OR TI "social skills" OR TI "emotional skills" OR TI "cognitive skills" OR TI "outcome assessment" OR TI "treatment outcome" OR TI "patient outcome" OR TI "patient compliance" OR TI "patient adherence" OR TI "treatment compliance" OR TI "treatment adherence" OR TI "Medication compliance" OR TI "Medication adherence" OR TI "quality of life" OR TI "life quality" OR TI pain Expanders - Apply equivalent subjects
S2: ((MA (play AND playthings)) OR (MA virtual reality) OR (MA play therapy)) OR ((DE play) OR (DE playfulness) OR (DE play therapy) OR (DE virtual reality) OR (DE virtual reality exposure therapy) OR (DE games) OR (DE toys) OR (DE toy selection)) OR ((KW play) OR (KW "play therapy") OR (KW game) OR (KW "virtual reality") OR (KW toy) OR (KW clown)) OR (((TI play) AND (TI therapy)) OR ((TI play) OR (TI "play therapy") OR (TI "virtual reality") OR (TI game) OR (TI toy) OR (TI clown) OR MA "child life") OR (KW "child life") OR (TI "child life")))
S1: ((MA Child) OR (MA Infant) OR (MA Adolesent) OR (MA Minors) OR (MA Child Health) OR (MA child, hospitalized) OR (MA pediatrics) OR (MA Adolecent medicine) OR (MA Hospitals, pediatric) OR (MA Intensive care unit, pediatric)) OR ((DE hospitalized patients) OR (DE pediatrics)) OR (((KW child) OR (KW adolescent) OR (KW infant) OR (KW minors) OR (KW "child health") OR (KW "hospitalized child") OR (KW "hospitalized children") OR (KW pediatric) OR (KW paediatric) OR (KW "adolescent medicine") OR (KW "pediatric hospital") OR (KW "paediatric hospital")) OR ((KW "pediatric intensive care unit") OR (KW "paediatric intensive care unit") OR (KW Newborn) OR (KW youths) OR (KW teen) OR (KW baby) OR (KW babies))) OR (((TI Child) AND (TI hospitalized)) OR ((TI child) OR (TI infant) OR (TI adolescent) OR (TI minors) OR (TI "child health") OR (TI "hospitalized child") OR (TI "hospitalized children") OR (TI pediatric) OR (TI paediatric) OR (TI "adolescent medicine") OR (TI "Pediatric hospital") OR (TI "Paediatric hospital")) OR ((TI "pediatric intensive care unit") OR (TI "paediatric intensive care unit") OR (TI Newborn) OR (TI Youths) OR (TI teen) OR (TI baby) OR (TI babies)))

CENTRAL

ID	Search	Hits
#1	MeSH descriptor: [Adolescent] explode all trees	
#2	MeSH descriptor: [Child] explode all trees	
#3	MeSH descriptor: [Child Health] explode all trees	
#4	MeSH descriptor: [Child, Hospitalized] explode all trees	
#5	MeSH descriptor: [Infant] explode all trees	
#6	MeSH descriptor: [Minors] explode all trees	
#7	MeSH descriptor: [Pediatrics] explode all trees	
#8	MeSH descriptor: [Intensive Care Units, Pediatric] explode all trees	
#9	MeSH descriptor: [Hospitals, Pediatric] explode all trees	
#10	MeSH descriptor: [Adolescent Medicine] explode all trees	
#11	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10	
#12	(child* OR infant* OR newborn* OR baby OR babies OR youths OR teen* OR adolescent* OR minors OR pediatric* OR paediatric*):ti,ab,kw	
#13	MeSH descriptor: [Play and Playthings] explode all trees	
#14	MeSH descriptor: [Virtual Reality] explode all trees	

#15	MeSH descriptor: [Play Therapy] explode all trees
#16	#13 OR #14 OR #15
#17	(play* OR toy* OR clown* OR "virtual reality" OR game* OR "child life"):ti,ab,kw
#18	MeSH descriptor: [Outcome Assessment, Health Care] explode all trees
#19	MeSH descriptor: [Patient Outcome Assessment] explode all trees
#20	MeSH descriptor: [Treatment Outcome] explode all trees
#21	MeSH descriptor: [Patient Compliance] explode all trees
#22	MeSH descriptor: [Quality of Life] explode all trees
#23	MeSH descriptor: [Pain Management] explode all trees
#24	MeSH descriptor: [Pain] explode all trees
#25	MeSH descriptor: [Pain Perception] explode all trees
#26	MeSH descriptor: [Pain, Postoperative] explode all trees
#27	MeSH descriptor: [Pain Measurement] explode all trees
#28	MeSH descriptor: [Stress, Psychological] explode all trees
#29	MeSH descriptor: [Anxiety] explode all trees
#30	MeSH descriptor: [Fear] explode all trees
#31	MeSH descriptor: [Adaptation, Psychological] explode all trees
#32	MeSH descriptor: [Health Behavior] explode all trees
#33	MeSH descriptor: [Illness Behavior] explode all trees
#34	MeSH descriptor: [Social Skills] explode all trees
#35	MeSH descriptor: [Motor Skills] explode all trees
#36	MeSH descriptor: [Cognition] explode all trees
#37	#18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34 OR #35 OR #36
#38	("outcome assessment" OR (patient* AND outcome*) OR (patient* AND compliance) OR (patient* AND adherence) OR (treatment* AND outcome*) OR (treatment* AND compliance) OR (treatment* AND adherence) OR (medication* AND compliance) OR (medication* AND adherence) OR "quality of life" OR "life quality" OR pain* OR "psychological stress" OR anxiety OR fear OR "psychological adaptation" OR "health behavior" OR "illness behavior" OR skill*):ti,ab,kw
#39	(#11 OR #12) AND (#16 OR #17) AND (#37 OR #38)
#40	MeSH descriptor: [Psychiatry] explode all trees
#41	MeSH descriptor: [Mental Disorders] explode all trees
#42	#40 OR #41
#43	((mental AND disorder*) OR (mental AND illness*) OR "mentally ill" OR psychiatry OR psychiatric*):ti,ab,kw
#44	#39 NOT (#42 OR #43) with Cochrane Library publication date Between Jan 2000 and Jun 2019
#45	(child* OR infant* OR newborn* OR baby OR babies OR youths OR teen* OR adolescent* OR minors OR pediatric* OR paediatric*):ti,kw
#46	(play* OR toy* OR clown* OR "virtual reality" OR game*):ti,kw
#47	("outcome assessment" OR (patient* AND outcome*) OR (patient* AND compliance) OR (patient* AND adherence) OR (treatment* AND outcome*) OR (treatment* AND compliance) OR (treatment* AND adherence) OR (medication* AND compliance) OR (medication* AND adherence) OR "quality of life" OR "life quality" OR pain* OR "psychological stress" OR anxiety OR fear OR "psychological adaptation" OR "health behavior" OR "illness behavior" OR skill*):ti,kw
#48	(#11 OR #45) AND (#16 OR #46) AND (#37 OR #47)
#49	#48 NOT (#42 OR #43) with Publication Year from 2000 to present, in Trials

Supplemental Table 2. Characteristics of included quantitative studies (n=280), the different colours represent the different clinical contexts

Clinical context, role of play	Study Identification	Journal	Study design*	Title	Aim	Number of participants	Intervention vs. comparator group(s) (number)	Age of participants (years)	Intervention(s)	Outcome	Tool(s) for assessment	Professions involved	Disease category	Procedure	Type of play	Self-directed vs. facilitated
Procedures and diagnostics (Distraction)	Schneider et al. 2000, USA	Pediatric nursing	Intervention study with no comparator group	Virtual reality as a distraction intervention for older children receiving chemotherapy.	To describe the perceived effectiveness and feasibility of using virtual reality as a distraction intervention for children receiving outpatient chemotherapy.	12	No comparator group	10 to 17	VR distraction during chemotherapy (40-120 min)	Treatment experience with VR distraction	Open ended Evaluation of Virtual Reality Intervention questions	Nurses	Oncology, non-specified cancer	Chemotherapy	Digital media (VR)	Self-directed
	Kleiber et al. 2001, USA	Journal of Pain and Symptom Management	Clinical study using randomisation	Parents as distraction coaches during IV insertion: a randomized study	To investigate the effectiveness of a brief Distraction Education intervention for parents prior to their preschool children's medical procedures	44	22 vs. 22	4 to 7	Distraction Education prior to IV insertion vs. standard care.	Use of distraction Distress Self-reported pain Discomfort	Observation Scale of Behavioral Distress-Revised "Oucher" Perception of Procedures Questionnaire-Revised	Not reported	Various chronic, non-life-threatening conditions such as chronic urinary tract infections, urinary incontinence, chronic constipation, growth failure, and reactive airway disease	IV insertion	Parent interaction (interactive books, blowing bubbles, surprise or novel toys, favorite stories)	Facilitated
	Dahlquist et al. 2002b, USA	Journal of Pediatric Oncology Nursing	Intervention study with no comparator group	Distraction for children of different ages who undergo repeated needle sticks.	To evaluate the immediate and long-term effectiveness of a nine-session distraction program and to test whether comparable treatment benefits can be achieved with different types of distractors, as long as they are multisensory, interactive, and variable, and involve active cognitive and motor responses from the child.	6	No comparator group	2 to 8	Several different cognitive distractors were used for the children based on their respective developmental levels.	Anxiety Pain Discomfort	Observed child distress, heart rate, parent ratings of the child's fear before the procedure	Nurses Doctors (medical residents)	Various hematological, oncological, and immunological disease	IM injections, SC port access or intravenous catheter insertion	Electronic toy	Facilitated
	Dahlquist et al. 2002a, USA	Health Psychology	Clinical study using randomisation on within subject design	Distraction intervention for preschoolers undergoing intramuscular injections and subcutaneous port access	To evaluate a distraction intervention designed to reduce the distress of preschool children undergoing repeated chemotherapy injections	29	29 (their own controls)	2 to 5	Distraction by a developmentally appropriate electronic toy vs. a wait-list control	Anxiety Pain Discomfort	Observed child distress (OSBD)	Nurses Therapists	Various hematological, oncological, and immunological disease	IM injections, SC port access	Touch and Discover toy	Self-directed
	Sander Wint et al. 2002, USA	Oncology nursing forum	Clinical study using randomisation on with mixed methods (pilot study)	Effects of distraction using virtual reality glasses during lumbar punctures in adolescents with cancer.	To determine the effects of virtual reality (VR) glasses on adolescents with cancer undergoing lumbar punctures (LPs).	30	17 vs. 13	10 to 19	VR-film during procedure (LP) vs. standard care	Pain Subjective evaluation of experience	Visual analog scale (VAS) Interviews to evaluate their experience	Nurses	Oncology, various haematological cancers	Lumbar Punctures	Digital media (VR)	Self-directed
	Gershon et al. 2004, USA	Journal of the American Academy of Child and Adolescent Psychiatry	Clinical study using randomisation (pilot study)	A pilot and feasibility study of virtual reality as a distraction for children with cancer.	To pilot and test the feasibility of a novel technology to reduce anxiety and pain associated with an invasive medical procedure in children with cancer.	59	22 vs. 15 vs. 22	7 to 19	Virtual reality distraction vs. a non to virtual reality distraction vs. treatment as usual without a distraction	Pain Anxiety	Pulse rate VAS, CHEOPS	Nurses Researchers	Oncology, non-specified cancer	Access to subcutaneous venous port device	Digital media (VR, VG)	Self-directed
	Maclaren & Cohen 2005, USA	Journal of Pediatric Psychology	Clinical study using randomisation	A comparison of distraction strategies for venipuncture distress in children.	To compare the effects of two pediatric venipuncture distress-management distraction strategies that differed in the degree to which they required children's interaction.	88	29 vs. 30 vs. 29	1 to 7	(1) Standard care (control): routine child interaction (2) Interactive toy distraction (3) Movie distraction	Distress	Videotapes, A modified version of the Observation Scale of Behavioral Distress, Nurse/caregiver distraction behavior, Child's engagement, VAS (child report, nurse report, caregiver report)	Nurses	Surgical diseases, not specified	Venipuncture	Interactive toy	Facilitated

Das et al. 2005, Australia	BMC Pediatrics	Clinical study using randomisation within subject design (pilot study)	The efficacy of playing a virtual reality game in modulating pain for children with acute burn injuries: a randomized controlled trial	To investigate whether playing a virtual reality game, decreases procedural pain in children with acute burn injuries.	7	7 (crossover)	5 to 18	Routine pharmacological analgesia or routine pharmacological analgesia coupled with virtual reality were randomly assigned to each half of the burns dressing change	Pain	Modified self-report Faces pain scale, Interviews	Nurses Data collector	Surgical diseases, burns	burns dressing changes	Digital media (VR)	Self-directed
Wolitzky et al. 2005, USA	Psychology & Health	Clinical study using randomisation with mixed methods	Effectiveness of virtual reality distraction during a painful medical procedure in pediatric oncology patients	To examine the effectiveness of virtual reality as a behavioral intervention designed to decrease distress during port access procedure	20	10 vs. 10	7 to 14	Immersive VR environment during the procedure vs. No VR control condition	Anxiety Distress	Pulse rate, The children's hospital of eastern ontario pain scale (CHEOPS), linterview, How-I-Feel questionnaire(anxiety) VAS(pain) VAS(anxiety)	Nurses	Oncology, non-specified cancer	Painful medical procedure	Digital media (VR)	Self-directed
Sinha et al. 2006, USA	Pediatrics	Clinical study using randomisation	Evaluation of nonpharmacologic methods of pain and anxiety management for laceration repair in the pediatric emergency department.	To assess the effectiveness of distraction techniques in reducing the sensory and affective components of pain among pediatric patients undergoing laceration repair in the ED.	240	120 vs. 120	6 to 18	Age-appropriate distracters including music, video games, or cartoon video. For children who did not show interest in any of these distracters, the certified child life worker offered to read a book or help blowing bubbles during the procedure.	Pain, anxiety, pain distress percieved by parent	The 7-point Facial Pain Scale (FPS), The State Trait Anxiety Inventory for Children (STAIC), VAS (pain)	Child life specialists Unspecified healthcare professionals (staff in emergency department)	Emergency Medicine/care, laceration	Laceration repair	Digital media (VG), cartoon, music	Facilitated
Gold et al. 2006, USA	CyberPsychology & Behavior	Clinical study using randomisation	Effectiveness of virtual reality for pediatric pain distraction during i.v. placement.	To compare a new VR pain distraction scenario with standard of care for reducing pain with IV placement. Secondary aims focused on the relationship between child, parent, and nurse pre- and post-assessments of pain, anxiety, generalized distress surrounding IV placement, and satisfaction with pain management.	20	10 vs. 10	8 to 12	Children in the VR distraction group began interacting with the VE at 5 min prior to the IV placement, continued play throughout, and interacted with the VR for 5 subsequent min.The virtual environment featured a fast-moving reality-based world in which the player races downhill lying on top of a big skateboard during	Pain, anxiety, distress, satisfaction	VAS, Wong-Baker Faces Pain Rating Scale, Faces Pain-Scale Revised, Chilhood Anxiety Sensitivity Index, Child Simulator Sickness Questionnaire, Child Presence Questionnaire; satisfaction questionnaires	Doctors (radiologists) Research assistants	Not specified	IV placement (children awaiting outpatient magnetic resonance imaging (MRI) or CT scans)	Digital media (VR)	Self-directed
Golden et al. 2006, USA	Anesth Analg	Clinical study using randomisation	Giving toys to children reduces their anxiety about receiving premedication for surgery.	To determine whether giving a small toy to a child would decrease anxiety and apprehension associated with taking oral premedication.	100	50 vs. 50	3 to 6	Children who came on even numbered dates of the month were included in the toy group and given a toy at a designated time preoperatively	Anxiety	Modified Yale Preoperative Anxiety Scale (mYPAS)	Nurses	Surgical diseases, such as tonsillectomy, hernia repair, or minor, urogenital procedures	Surgery	Toys	Self-directed
Patel et al. 2006, USA	Pediatric Anesthesia	Clinical study using randomisation	Distraction with a hand-held video game reduces pediatric preoperative anxiety.	To evaluate the efficacy of an interactive distraction, a handheld video game (VG) in reducing preoperative anxiety in children.	112	38 (VG) vs. 38 (M) vs. 36 (PP)	4 to 12	1) Parent presence, 2) PP + a hand-held VG, 3) PP + 0.5 mg/kg) 1 oral midazolam (M) given >20 min prior to entering the operating room.	Anxiety	Modified Yale Preoperative Anxiety Scale (mYPAS), Posthospitalization Behavior Questionnaire	Nurses	Not specified	Surgery	Digital media (VG)	Self-directed
Windich-Biermeier et al. 2007, USA	Journal of Pediatric Oncology Nursing	Clinical study using randomisation with mixed methods	Effects of distraction on pain, fear, and distress during venous port access and venipuncture in children	To evaluate the effect of self-selected distracters on the outcomes of pain, fear, and distress in children and adolescents with cancer, ages 5 to 18, around venous port access or venipuncture	50	28 vs. 22	5 to 18	Self-selected distracters (bubbles, book, music table, VR, VG) and parenst instructed to actively coach the child to use the distraction item.	Pain, fear, distress	Pain: Color Analogue Scale (CAS), Fear: The Glasses Fear Scale (variation of VAS), distress: Observation Scale of Behavioral Distress (OSBD),	Nurses (oncology)	Oncology, various cancers such as leukemia, lymphoma, a solid tumor, or histiocytosis	Venous port access and venipuncture	Toys, books, digital media (VR, VG)	Facilitated

Chan et al. 2007, Taiwan	Journal of Clinical Nursing	Clinical study using randomisation on within subject design	Application of a virtual reality prototype for pain relief of pediatric burn in Taiwan	To examine the usability and effectiveness of virtual reality in reducing pain in wound-care procedures for pediatric burn patients	8	8 (crossover)	mean of 6.5 (SD 2.3)	The experimental condition consisted of the conventional treatment for pain along with the use of VR game during the dressing change procedure. The process of changing their dressings(15 to 20 minutes).	Pain Anxiety	Self-reported faces pain scale modified presence questionnaires	Nurses	Surgical diseases, burns	Wound care procedures/Dressing change	Digital media (VR)	Self-directed
Denman et al. 2007, USA	Pediatric Anesthesia	Intervention study with no comparator group	The PediSedate device, a novel approach to pediatric sedation that provides distraction and inhaled nitrous oxide: clinical evaluation in a large case series.	To determine the acceptability and safety of the Pedi-Sedate device.	100	No comparator group	3 to 9	PediSedate provides sedation through a combination of inhaled nitrous oxide and distraction by video game	Incidence of treatment failure, airway patency, degree of sedation	Records of patients inability to accept the device, and hypoxemia or airway obstruction. Airway patency (1 to 4 scale). Ramsey Scale (sedation). Acceptance (1 to 3 scale).	Not reported	Surgical diseases, not specified	Surgery	Digital media (VG)	Self-directed
Mott et al. 2008, Australia	Burns	Clinical study using randomisation	The efficacy of an augmented virtual reality system to alleviate pain in children undergoing burns dressing changes: a randomised controlled trial	To investigate the use of AR as an adjunct to analgesia and sedation in children with acute burns.	42	20 vs. 22	3 to 14	Augmented reality as an adjunct to analgesia and sedation	Pain, pulse rate, respiratory rates, oxygen saturation, parents percieved child pain	Pulse oximeter, pain (accoring to age) FLACC (faces, legs, activity, cry and consolability), FPS-R (faces pain scale-revised), VAS (visual analogue scale)	Nurses (burns)	Surgical diseases, burns	dressing changes	Digital media (AR)	Self-directed
Hedén et al. 2009, Sweden	European Journal of Cancer Care	Clinical study using randomisation	Randomized interventions for needle procedures in children with cancer.	To examine whether children experience less fear, distress and pain connected to a routine needle insertion in an intravenous port when subjected to an intervention: blowing soap bubbles or having a heated pillow vs. standard care.	28	14 vs. 14	2 to 7	During the needle insertion in the standard care + blowing soap bubbles condition, the children were encouraged to look at the soap bubbles flying around in the room. During the needle insertion in the standard care + heated pillow condition, the children were requested to 'feel the pleasant, cosy heat' on the place on the body where the child had chosen to place the heated pillow.	Fear, distress, pain	Parent and nurse reported VAS score (fear, distress and pain)	Nurses (oncology)	Oncology, non-specified cancer	Needle-related (intravenous port)	Soap bubbles	Facilitated
Nilsson et al. 2009, Sweden	European journal of oncology nursing	Non-randomised clinical study with mixed methods	The use of Virtual Reality for needle-related procedural pain and distress in children and adolescents in a paediatric oncology unit.	To examine and survey the effect of using non-immersive VR, i.e. a 3D display, during a needle-related procedure on reported pain or distress of children and adolescents in a paediatric oncology unit. To examine their response to the use of VR equipment during the procedure.	42	21 vs. 21	2 to 18	The intervention consisted of a virtual world game/application, "The hunt of the diamonds'"	Pain and distress	Colour Analogue Scale (CAS), Facial Affective Scale (FAS), Face, Legs, Activity, Cry and Consolability scale (FLACC) (nurse observer), heart rate. Semi-structured qualitative interviews	Nurses (oncology)	Oncology and haematology various cancers (leukemias, lymphomas, solid tumours and some haematological disease)	Needle-related	Digital media (VR)	Self-directed
Tüfekci et al. 2009, Turkey	Journal of Clinical Nursing	Quasi-randomised clinical study	Turkish children loved distraction: using kaleidoscope to reduce perceived pain during venipuncture	To assess the effect of distraction (looking through kaleidoscopes) to reduce perceived pain, during venipuncture in healthy school-age children.	206	105 vs. 101	7 to 11	After the children, accompanied by their parents (mother and/or father) in the intervention group, were admitted to waiting room for venipuncture, they were introduced to a kaleidoscope and then instructed as to how they could use the kaleidoscope	Pain	Wong to Baker FACES Pain Rating Scale, Visual Analogue Scale	Nurses	Not specified	Needle-related (Venipuncture)	Toy	Self-directed

Miller et al. 2010, Australia	Burns	Clinical study using randomisation	Multi-modal distraction. Using technology to combat pain in young children with burn injuries.	(1) To investigate if MMD procedural preparation (MMD-PP) and MMDdistraction (MMDD) has a greater impact on child pain reduction compared to standard distraction (SD) and hand held games distraction (VG), (2) to understand the impact of MMD on clinic efficiency by measuring length of treatment across groups, and lastly (3) To assess the efficacy of MMD over three dressing change procedures.	80	20 vs. 20 vs. 20 vs. 20	3 to 10	Multi-modal distraction (MMD), MMDprocedural preparation (MMD-PP) or distraction (MMDD). Patient randomized to four groups: (1) Standard (SD), (2) off the shelf hand held video game (VG=play station), (3) MMD procedural preparation (MMD-PP), and (4) MMD Distraction (MMD-D).	Pain, lenght of procedure	The Wong Baker Faces (FACES), VAS (caregiver percieved pain), Faces, Legs, Activity, Cry and Consolability scale (FLACC) (nurse observed pain), pulse oximeter	Nurses (burns)	Surgical diseases, burns	Dressing change	Digital media (VG)	Self-directed
Miller et al. 2011, Australia	Burns	Clinical study using randomisation	A novel technology approach to pain management in children with burns: A prospective randomized controlled trial.	To determine whether levels of pain and distress using a combined preparation and distraction content can be further reduced, and offer more efficient clinical outcomes	40	20 vs. 20	3 to 10	Multi-modul-distraction (MMD). The MMD device is a customized hand held technology device that is interactive for the child through movement, touch screen and multi-sensory feedback (including visual, auditory and vibration). It has two components: (1) preparation for a procedure; and (2) distraction content, that includes games, and touch and find stories.	Pain	Pain intensity at 4 time points using: Wong Baker Faces Scale (FACES) visual analogue scale (VAS) The Faces, Legs, Activity, Cry and Consolability scale (FLACC) Pulse rate (pulse oximetry at 2-min intervals) Economic measures: length of treatment, days to heal and medication usage, adverse pain events	Nurses	Surgical diseases, burns	Acute burn care	Multi-modul-distraction device	Self-directed
Singh 2012, India	Nursing Journal of India	Non-randomised clinical study	Effect of distraction techniques in behaviour responses to pain among toddlers receiving immunisation.	1. To determine the behavioural responses to pain among toddlers who are given a toy as distraction (Group I) during immunisation. 2. To determine the behavioural responses to pain among toddlers who are given music as a distraction (Group II) during immunisation. 3. To determine the behavioural responses to pain among toddlers in the control group - no intervention (Group III) during immunisation. 4. To compare the behavioural responses to pain in Group I, Group II and Group III in toddlers during immunisation.5. To find association between behavioural responses to pain score and selected demographic variables of toddlers during immunisation.	90	30 vs. 30 vs. 30	1 to 3	Toy vs music vs routine care	Pain (response to pain)	FLACC (modified)	Nurses	Other, immunisation	needle-related procedure	Toys, music	Facilitated
Kipping et al. 2012, Australia	Burns	Clinical study using randomisation*	Virtual reality for acute pain reduction in adolescents undergoing burn wound care: a prospective randomized controlled trial.	To assess off-the-shelf VR for (1) its effect on reducing acute pain intensity during adolescent burn wound care, and (2) its clinical utility in a busy hospital setting	41	20 vs. 21	11 to 17	The VR group (VRG) received distraction via an off-the-shelf VR system, which included a head mounted display, joystick hand control, personal computer and off the shelf, age appropriate software games (Chicken Little for the 11 to 13 years old, and an additional choice of Need for Speed for	Pain, lenght of treatment	VAS (adolescent/caregiver/nursing)	Nurses	Surgical diseases, burns	Wound care	Digital media (VR)	Self-directed

								the 14 to 17 years old).						
Minute et al. 2012, Italy	Medical and surgical pediatrics	Clinical study using randomisation	Videogame playing as distraction technique in course of venipuncture.	To investigate the efficacy of an active distraction strategy (video-game playing) compared to our standard procedure (topical anesthetic cream) in children 4 to 10 years of age.	97	47 vs. 50	4 to 10	A simple videogame, *Wii-Play* R,rated 3+, in which the child had to aim to different targets using a single-handed remote as a pointer.	Pain, reaction to pain	FLACC (Face, legs, Activity, Crying and Consolability), Faces Pain Scale revised (FPS-r)	Nurses	Not specified	Venipuncture	Digital media (VG)	Self-directed
Wolyniez et al. 2013, Israel	Clinical Pediatrics	Clinical study using randomisation (pilot study)	The effect of a medical clown on pain during intravenous access in the pediatric emergency department: a randomized prospective pilot study.	To test the hypothesis that the participation of medical clowns during a painful procedure involving intravenous cannulation or the taking of a blood sample in the pediatric ED would reduce the child's pain and the parent's anxiety.	47	26 vs. 21	3 to 16	The group randomized to the medical clown spent 15 minutes with the medical clown before the procedure. A single medical clown was involved in the study to reduce variation in technique.	Pain, parental anxiety	Faces Pain Scale to Revised, VAS, State-Trait Anxiety (parental)	Not reported	Emergency medicine, not specified	intravenous access	Medical clown	Facilitated
Matziou et al. 2013, Greece	British Journal of Nursing	Clinical study using randomisation	Parental Presence and Distraction during Painful Childhood Procedures	To investigate the effect of parental presence and the distraction of the attention by a toy in children undergoing a painful procedure	130	43 vs. 44 vs. 43	7 to 10	Group 1) Parental presence (parent instructed not to talk to child nor to distract it). Group 2) Toy: The child was given a kaleidoscope 3-5 minutes before procedure. No parent present. Group 3) Control gruop. No parent or toys	Pain, anxiety, vital signs of stress	Numerical rating scale (pain), State-Trait Anxity Inventory for Children, heart rate, respiratory rate, blood pressure	Nurses	Not specified	Venipuncture	Toys	Self-directed
Nilsson et al. 2013, Sweden	Journal of pediatric nursing	Clinical study using randomisation	Active and passive distraction in children undergoing wound dressings.	To test if serious gaming and lollipops influence pain, distress and anxiety in conjunction with a wound care session.	60	20 vs. 20 vs. 20	5 to 12	Lollipop: The children chose from different coulored lollipops. Game: Each path lasted for approximately 1 to 5 minutes and differed in difficulty.	Pain behavior, pain intensity, distress, anxiety	Coloured Analouge Scale (CAS), Facial Affective Scale (FAS), State-Trait Anxiety Inventory (STAI), Face, Legs, Activity, Cry and Consolability (FLACC)	Nurses (wound care)	Emergency medicine/care, minor surgical diseases	Wound dressing	Digital media (VG)	Self-directed
Sadeghi et al. 2013, Iran	Journal for Specialists in Pediatric Nursing	Quasi-randomised clinical study	Effect of distraction on children's pain during intravenous catheter insertion.	To examine the effect of pressing a soft ball as a distraction tool during IVCI on the intensity of pain in children between 4 and 6 years of age.	60	30 vs. 30	4 to 6	Pressing a soft ball in the opporsite hand vs. standard care	Pain	Wong to Baker FACES Pain Rating Scale.	Nurses (paediatric)	Surgical diseases such as hernia, tonsillectomy, urinary tract surgury, gastric tract surgery, others	Intravenous catheter insertion	Toy	Self-directed
Basari-Moghada et al. 2014, Iran	The Journal of the Pakistan Medical Association	Clinical study using randomisation	Comparison of EMLA cream with rattles on reducing immunization pain in four months infants	To assess the effect of Eutectic Mixture of Local Anaesthetics cream and rattle on soothing the vaccination pain on four-month-infants.	50	16 vs. 16 vs. 18	0.33	Intervention: Rattle: shaken from 30s before administration to 15s afterward as a source of distraction. Comparator: EMLA. Control: Standard care	Pain behavioral response	Infants' pain questionnaire, which is a modified scale of pain behavioural response for 4-6 months infants,	Not reported	Other, immunisation	Needle-related procedure	Toy	Facilitated
Goldberg et al. 2014, Israel	Allergy	Clinical study using randomisation	Medical clowns ease anxiety and pain perceived by children undergoing allergy prick skin tests	To evaluate whether medical clowns can diminish pain and anxiety perceived by children undergoing allergy skin prick tests (SPT)	91	45 vs. 46	2 to 17	Company with clown vs. standard procedure	Anxiety Pain	m-YPAS and STAI/ STAIC before and after SPT FLACC (2-7 years) VAS (8 years or older)	Hospital clown Doctors (allergists) Psychologists	Pulmonology, allergy	Allergy prick skin test	Medical clown	Facilitated
Weintraub et al. 2014 Israel	Israel Medical Association Journal	Intervention study with no comparator group	Medical clowns facilitate nitrous oxide sedation during intra-articular corticosteroid injection for juvenile idiopathic arthritis.	To prospectively evaluate whether a medical clown affects pain perception during intra-articular corticosteroid injection in juvenile idiopathic arthritis using nitrous oxide conscious sedation.	32	No comparator group	5 to 18	A medical clown was present in the room during the entire procedure	Pain	VAS (patient, parent, nurse, clown, physician)	Nurses Doctors (rheumatologists)	Rheumatology, juvenile idiopathic arthritis.	Intra-articular corticosteroid injection	Medical clown	Facilitated

Hua et al. 2015, China	Pain Management Nursing	Clinical study using randomisation	The Effect of Virtual Reality Distraction on Pain Relief During Dressing Changes in Children with Chronic Wounds on Lower Limbs.	To preliminarily investigate the effect of this VR distraction system on alleviating pain during dressing changes in children with chronic lower-limb wounds	65	33 vs. 32	4 to 16	Before the dressing change, a trained nurse introduced the VR equipment to the children of the VR distraction group in the waiting room	Pain, anxiety, time lenght for dressing changes	Wong-Baker Faces (FACES), Face, Legs, Activity, Cry, Consolability (FLACC), VAS, pulse rate, oxygen saturation	Nurses	Surgical diseases, chronic wounds	Wound dressing change	Digital media (VR)	Self-directed
Crevatin et al. 2016, Italy	Acta Paedeiatrica	Clinical study using randomisation	Hand-held computers can help to distract children undergoing painful venipuncture procedures	To assess the effectiveness of playing a computer game during venipuncture, compared with low-tech distraction by a nurse	200	100 vs. 100	4 to 13	Angry Birds on a hand-held computer vs. distraction by a second, specifically trained nurse who sang to them, read a book, blew bubbles or played with puppets.	Pain	Faces Pain Scale-Revised (4-7y) Numeric rating scale (8-13y)	Nurses	Not specified	Needle-related (Venipuncture)	Digital media (VG), therapeutic play	Facilitated
Felluga et al. 2016, Italy	European Journal of Pediatrics	Quasi-randomised clinical study	A quasi randomized-controlled trial to evaluate the effectiveness of clowntherapy on children's anxiety and pain levels in emergency department.	To investigate if the presence of medical clowns during painful procedures in the emergency department (ED) affects children's anxiety and pain.	40	20 vs. 20	4 to 11	Clown intervention: Children interacted with clowns Control group: Children were entertained by parents and ED nurses.	Anxiety Pain	Children's Anxiety and Pain Scales, Numerical Rating Scale, Wong-Backer Scale	Hospital clown Nurses	Emergency medicine, not specified	Painful procedures	Medical clown	Facilitated
Meiri et al. 2016, Israel	European Journal of Pediatrics	Clinical study using randomisation	The effect of medical clowning on reducing pain, crying, and anxiety in children aged 2-10 years old undergoing venous blood drawing--a randomized controlled study.	To compare the utilization of medical clowning in this process with two control groups: (1) local anesthetic cream applied prior to the procedure (active control) and (2) the procedure performed with neither clown nor EMLA (control group)	100	3 groups (n not specified)	2 to 10	Medical clown doing balloons, humorous noises of animals, playing an accordion, and singing funny songs. The process started 10 min before the blood exam and was completed when the child left the room after venipuncture/IV placement	Pain, crying, anxity	Pain level evaluated by the child was based on a scale of 10 faces (with numbered scale under the faces), VAS (anxiety+pain parent reported), crying time	Nurses Hospital clown Doctors	Not specified	Venous blood drawing or intravenous cannulation	Medical clown	Facilitated
Miller et al. 2016, Australia	Pediatric Emergency Care	Clinical study using randomisation	A Prospective Randomized Controlled Trial of Nonpharmacologic al Pain Management During Intravenous Cannulation in a Pediatric Emergency Department.	To examine which among 5 types of interventions has a greater impact on reducing pain and distress for children aged 3 to 12 years, undergoing IV cannulation in the ED.	98	20 vs. 20 vs. 20 vs. 19	3 to 12	(1) Standard Distraction (StDis), (2) PlayStation Portable (PSP) (Sony, Japan), (3) Ditto Distraction (Ditto-D), (4) Ditto Procedural Preparation (Ditto-PP), and (5) Ditto Combined Procedural Preparation and Distraction (Ditto-C).	Pain	Wong Baker Faces (FACES) Scale, VAS, Faces, Legs, Activity, Cry and Consolability Scale	Nurses	Emergency medicine, not specified	Intravenous cannulation	Digital media (VG)	Facilitated
Rimon et al. 2016, Israel	The Israel Medical Association journal	Clinical study using randomisation (pilot study)	Medical Clowns and Cortisol levels in Children Undergoing Venipuncture in the Emergency Department: a Pilot Study	To investigate whether medical clown-assisted interventions to reduce child's distress during venipuncture have an effect on cortisol levels	53	29 vs. 24	2 to 15	Medical clown 15 min before and presence of medical clown vs. (reduced) standard care	Pain	The Faces Pain Scale -revised (FPS-R) for the 4 to 7 year age group and the visual analog scales (VAS) for those aged 8 to 15 years	Hospital clown Nurses	Emergency medicine	Venipuncture	Medical clown	Facilitated
Karakaya & Gözen 2016, Turkey	Pain Management Nursing	Clinical study using randomisation	The Effect of Distraction on Pain Level Felt by School-age Children During Venipuncture Procedure-Randomized Controlled Trial.	To determine the effect of distraction with a kaleidoscope on the pain level in children while they undergo venipuncture	144	72 vs. 72	7 to 12	A kaleidoscope to look through during the procedure. The researcher asked children to tell what they saw in the glass (shapes, colors) during the procedure	Pain	Child and Family Information Form, Faces Pain Scale to Revised (FPS-R), pulse oximeter device, noncontact thermometer	Nurses	Not specified	Venipuncture	Toy (kaleidoscope)	Self-directed

Ballard et al. 2017, Canada	Pain Mangement Nursing	Intervention study with no comparator group (pilot study)	Distraction Kits for Pain Management of Children Undergoing Painful Procedures in the Emergency Department: A Pilot Study.	To assess the feasibility, usefulness, and acceptability of using distraction kits, tailored to age, for procedural pain management of young children visiting the emergency department and requiring a needle-related procedure	50	No comparator group	0.33 to 5	Age-tailored distraction kit	Pain	Face, Legs, Activity, Cry, Consolability scale	Nurses	Emergency medicine	Needle related procedures	Toy	Facilitated
Ben-Pazi et al. 2017, Israel	PLOS ONE	Quasi-randomised clinical study within subject design	Clown-care reduces pain in children with cerebral palsy undergoing recurrent botulinum toxin injections- A quasi-randomized controlled crossover study	To investigate the impact of clown-care on pain in children with cerebral palsy who undergo recurrent Botulinum-toxin injections	45	20 vs. 25 (crossover)	1.5 to 18	Clown intervention during procedure vs. standard care	Pain	Pain Visual-Analogue-Scale (range 1-5) Effectiveness questionnaires	Doctors Hospital clown Nurses	Neurology. cerebral palsy	Botulinum-toxin injections	Medical clown	Facilitated
Lestari et al. 2017, Bali-Indonesia	Comprehensive Child and Adolescent Nursing,	Quasi-randomised clinical study*	The Effectiveness of Distraction (Cartoon-Patterned Clothes and Bubble-Blowing) on Pain and Anxiety in Preschool Children during Venipuncture in the Emergency Department	To identify the differences between cartoon-patterned clothes and bubble-blowing in terms of their efficacy as a distraction from pain and anxiety in preschoolers during venipuncture.	57	19 vs. 19 vs. 19	3 to 6	Distraction Group 1 (cartoon-patterned outfit), Distraction Group 2 (bubble-blowing) vs. Control group	Anxiety Pain	Face, Leg, Activity, Cry Consolability Children's Fear Scale (CFS), which was developed by McMurtry, Noel, Chambers, and McGrath	Nurses Researchers Research assistants	Not specified	Venipuncture	Playful nurse clothes or bubbles	Facilitated
Meiri et al. 2017, Israel	The Israel Medical Association journal	Clinical study using randomisation	Assistance of medical clowns improves the physical examinations of children aged 2 to 6 years	To evaluate the use of medical clowns to assist during initial physical examinations in the ER setting	93	44 vs. 49	2 to 6	Physical exam with the assistance of a medical clown (distraction through singing, dancing, doing magic tricks) in the presence of a caregiver vs. Physical exam by a pediatrician alone in the presence of a caregiver	Duration procedure and crying phase, child's discomfort, anxiety, quality of the physical examination.	Questionnaires for clinicians and for caregivers Resistance to the physical exam estimated by the pediatrician based on a scale of 0 to 4	Hospital clown Doctors	Emergency medicine, not specified	Physical examination in ER	Medical clown	Facilitated
Bumin Aydın et al. 2017, Turkey	Journal of Clinical Anesthesia	Clinical study using randomisation	The effect of play distraction on anxiety before premedication administration: a randomized trial.	To assess the role of distraction in the form of playing with play dough (Play-Doh) on reducing premedication anxiety in children.	52	52 vs. 52	3 to 7	Play dough or not before administration of oral premedication.	Anxiety	Modified Yale Preoperative Anxiety Scale (mYPAS)	Doctors (anesthesiologists)	Surgical diseases, not specified	Elective surgery	Play dough	Self-directed
Marechal et al. 2017, France	British Journal of Anaesthesia	Clinical study using randomisation	Children and parental anxiolysis in paediatric ambulatory surgery: a randomized controlled study comparing 0.3 mg kg-1 midazolam to tablet computer based interactive distraction	To compare the effects of midazolam for premedication with age-appropriate tablet game apps on children anxiety during and after ambulatory surgery	118	60 vs. 58 (55 for analyses)	4 to 11	Age-appropriate tablet game apps vs. midazolam for premedication	Anxiety	Change in m-YPAS StateTrait Anxiety Inventory (STAI) (parents) Post Hospital Behavior Questionnaire	Psychologists Unspecified healthcare professionals (anaesthetic team)	Surgical diseases, minor surgical diseases	General aneasthesia	Digital media (VG)	Self-directed
Birnie et al. 2018, Canada	Journal of Pediatric Oncology Nursing	Intervention study with no comparator group (pilot study)	Usability Testing of an Interactive Virtual Reality Distraction Intervention to Reduce Procedural Pain in Children and Adolescents With Cancer	To assessthe the usability of a custom VR intervention for children with cancer undergoing implantable venous access device (IVAD) needle insertion.	17	No comparator group	8 to 18	Three iterative cycles of mixed-method usability testing with semistructured interviews were undertaken to refine the VR.	Ease of use and acceptability	No specific scales were applied	Doctors Research assistants	Oncology, non-specified cancers	Needle-related	Digital media (VR)	Self-directed
Chad et al. 2018, USA	Pain Mangement Nursing	Intervention study with no comparator group (pilot study)	Effect of virtual reality headset for pediatric fear and pain distraction during immunization.	To investigate the rationale, feasibility and results of a pilot study applying a virtual reality (VR) headset as a fear reduction and pain distraction during immunizations.	17	No comparator group	6 to 17	VR goggles with the subject choosing a roller coaster ride, helicopter ride or hot-air balloon ride VR experience prior to VR headset placement	Anxiety, Pain	Wong to Baker pain scale, McMurtry children's fear scale	Researchers Doctors	Other, immunisation	Needle-related procedure	Digital media (VR)	Self-directed

Chau et al. 2018, USA	Journal of Pediatric Rehabilitation Medicine	Intervention study with no comparator group (pilot study)	Decreasing pediatric pain and agitation during botulinum toxin injections for spasticity with virtual reality: Lessons learned from clinical use	To assess feasibility and use of treating BoNT procedure-related discomfort in pediatric patients with VR	14	No comparator group	mean 7.79 ± 2.39 SD	VR videos using a mobile VR headset during the procedure.	Pain Anxiety Agitation	Face, Legs, Activity, Cry, Consolability scale (FLACC) scores	Unspecified healthcare professionals Doctors	Neurology, cerebral palsy	Botulinum toxin injection	Digital media (VR)	Self-directed
Gerçeker et al. 2018, Turkey	Journal of PeriAnesthesia Nursing	Clinical study using randomisation	Effects of Virtual Reality and External Cold and Vibration on Pain in 7- to 12-Year-Old Children During Phlebotomy: A Randomized Controlled Trial	To evaluate the effects of the virtual reality (VR) and external cold and vibration methods on pain scores in children aged 7 to 12 years during phlebotomy.	121	40 vs. 41 vs. 40	7 to 12	VR group, the researcher explained to the child how to implement the VR and offered options, which cartoon videos the child could watch vs. Buzzy, a reusable plastic bee, which provides both cold application and vibration.	Pain	Wong-Baker FACES (WB-FACES) scale (self-reported, parent-reported, nurse-reported and researcher-reported)	NursesResearchers	Not specified	Venipuncture	Digital media (VR), "Buzzy" (cold, vibrating bee)	Self-directed
Piskorz & Czub 2018, Poland	Journal for Specialists in Pediatric Nursing	Quasi-randomised clinical study	Effectiveness of a virtual reality intervention to minimize pediatric stress and pain intensity during venipuncture	To test the effectiveness of virtual reality as well as assess the usability of a novel hands-free interface	38	19 vs. 19	7 to 17	VR distraction vs. standard procedure without distraction	pain stress	questionnaire VAS	Nurses	Nephro/urology, not specified	Needle-related (venipuncture)	Digital media (VR)	Self-directed
Houx et al. 2019, France	Annals of Physical and Rehabilitation Medicine	Quasi-randomised clinical study	Do clowns attenuate pain and anxiety undergoing botulinum toxin injections in children?	To compare the effectiveness of medical clowns and usual distractions, both added to nitrous oxide (N2O) and analgesic cream, on pain and anxiety during BTI sessions in children.	59	25 vs. 34	5 to 11	Clown distraction vs Usual distraction could consist of listening to music, watching television, playing video games or discussing topics of interest to the child	Pain, anxiety	Face, Legs, Activity, Cry, Consolability (FLACC), VAS (pain) VAS (anxiety)	Hospital clown	Spasticity (52 with CP but the remaining 7 is not reported?)	Botulinum toxin injections	Medical clowns	Facilitated
Longobardi et al. 2019, Italy	Child Care Health Development	Quasi-randomised clinical study (pilot study)	Soap bubbles as a distraction technique in the management of pain, anxiety, and fear in children at the paediatric emergency room: A pilot study	To assess the effectiveness of soap bubbles as a distraction technique for the management of anxiety, fear, and pain in children waiting for a medical examination at the paediatric emergency room	74	37 vs. 37	7 to 10	Children in the experimental group were involved in an activity in which research assistants blew big soap bubbles (about 50 to 100 cm) and asked children to interact with them by looking at, blowing, and/or popping the bubbles. vs Standard care	Anxiety Pain Fear	VAS (pain) Child Anxiety Meter (CAM) Fear Survey Schedule for Children to Revised	Researchers	Unspecified (minimal to moderate severity conditions in ED)	Medical examination	Soap bubbles	Facilitated
Newman et al. 2019, Israel	Pediatric Reports	Clinical study using randomisation	The impact of medical clowns exposure over postoperative pain and anxiety in children and caregivers: an Israeli experience	To assess the efficacy of preoperational medical clown therapy on post-operative pain and stress utilizing both standard questionnaires as well as serum cortisol as an objective stress marker.	45	22 vs. 23	mean 5.7	The clown interacted with both child and parents using various methods fitted to the child's age, language and mental ability.	Pain Stress	Wong-Baker Faces Pain Rating Scale, Cortisol (serum)	Hospital clown	umbilical or inguinal hernia repair surgery	Surgery	Medical clown	Facilitated
Yildirim et al. 2019, Turkey	Burns	Clinical study using randomisation	The effect of hospital clown nurse on children's compliance to burn dressing change	To investigate the effect of hospital clown-nurse on children's compliance to burn dressing change.	50	25 vs. 25	3 to 7	For the intervention group, there was a clown-nurse waiting for the child in the entrance of the intervention room and accompanied the child from the beginning to the end of dressing change. The clown used the distraction methods of making certain shaped balloons by using twisty balloons and facial painting	Behaviour	Purposemade observation form + questionnaire	Nurses	Burns	Dressing change	Clown Nurse	Facilitated

								according to child's preference of shape and colors							
Dabas 2019, India	International Journal of Nursing Education	Clinical study using randomisation	Effectiveness of Distraction Techniques on Pain Intensity during Immunization among Infants	To compare different forms of distraction to standard care, in reducing pain during immunization of infants.	100	25 vs. 25 vs. 25 vs. 25	0.19 to 0.26	Electronic toy vs. "key toy" vs. "simple toy" vs. no distraction	pain/distress	FLACC pain scale	Researchers Nurses?	Other, immunisation	Needle-related procedure	Toys (electronic toys vs. "key toys" vs. "simple toys")	Self-directed
Inan & Inal 2019, Turkey	The Clinical Journal of Pain	Clinical study using randomisation	The impact of 3 different distraction techniques on the pain and anxiety levels of children during venipuncture	To evaluate the effect of 3 different distraction methods on the pain and anxiety levels of children during venipuncture	180	45 vs. 45 vs. 45 vs. 45	6 to 10	Group A: Video games. Group B: Cartoon movie. Group C: Parent support group. Group D: Control group	Anxiety Pain	Children Fear Scale, Wong-Baker Pain Scale	Nurses	Not specified	Venipuncture	Digital media (VG)	Self-directed
Caruso et al. 2019, USA	Pediatric Anesthesia	Clinical study using randomisation	Virtual reality during pediatric vascular access: a pragmatic, prospective randomized, controlled trial	To determine whether pain would be reduced in pediatric patients using virtual reality undergoing vascular access.	220	106 vs. 114	7 to 18	Patients in the VR group were given one of three VR experiences named Ocean Rift (Picselica 2016), Pebbles the Penguin (Mighty Immersion 2016), or Space Pups (Mighty Immersion 2016) vs standard care (inclusive nurse coaching, TV and child life service when available)	Pain, fear, compliance, adverse effects	Faces Pain Scale-Revised (FPS-R) Child Fear Scale (CFS), modified Induction Compliance Checklist (mICC), and satisfaction surveys (purpose made)	Researchers	Various unspecified diseases (recruited from cancer center, preoperative center, emergency department etc.)	Needle-related (vascular access)	Digital media (VR)	Self-directed
Chan et al. 2019, Australia	The Journal of Pediatrics	Clinical study using randomisation with mixed methods*	Virtual Reality for Pediatric Needle Procedural Pain: two Randomized Clinical Trials	To assess the efficacy and safety of a virtual reality distraction for needle pain in 2 common hospital settings: the emergency department (ED) and outpatient pathology (ie, outpatient laboratory).	254	127 vs. 125 (ED: 64 vs. 59, pathology: 63 vs. 66)	4 to 11	The child interacted with the environment (eg, virtual fish) through gaze-based tracking. A short version was used for venipuncture and a longer sequence for intravenous cannulation vs standard care (involved age-appropriate distraction, such as child-life therapy, toys, books, and electronic devices.)	Pain, anxiety, procedural data (incl. adverse effects and time)	Faces Pain Scale-Revised (FPS-R) VAS (anxiety), procedural data, questionnaire (purpose made)	Proceduralists Researchers	Various unspecified diseases/injuries	Needle-related (vascular access)	Digital media (VR)	Self-directed
Dumoulin et al. 2019, USA	Games for Health Journal	Clinical study using randomisation	A Randomized Controlled Trial on the Use of Virtual Reality for Needle-Related Procedures in Children and Adolescents in the Emergency Department	To document the efficacy of VR as a mode of distraction during a medical procedure compared with two comparison conditions: watching television (TV, minimal control condition) and distraction provided by the Child Life (CL, gold standard control condition) program.	59	24 vs. 15 vs. 20	8 to 17	The VR intervention consisted of an immersive game developed by the UQO Cyberpsychology Lab vs TV watching vs Child Life Specialist distraction	Pain	Wong-Baker Faces Pain	Child Life Specialist, Researchers	Various unspecified diseases/injuries	Needle-related procedures (various kinds)	Digital media (VR)	Self-directed
Dwairej et al. 2019, Jordan	Journal for Specialists in Pediatric Nursing	Clinical study using randomisation	Video game distraction and anesthesia mask practice reduces children's preoperative anxiety: a randomized clinical trial	To evaluate the effectiveness of combined video game distraction and anesthesia mask exposure and shaping intervention as compared to conventional preoperative preparation on the preoperative anxiety, anesthesia induction compliance and emergence delirium of children undergoing day-case surgery.	128	64 vs. 64	5 to 11	The intervention group received combined interactive video distraction through the handheld video game and anesthesia mask exposure and shaping intervention. The control group received the usual care.	Anxiety, induction compliance, delirium	Modified Yale Preoperative Anxiety Scale (mYPAS), induction compliance checklist (ICC), Pediatric Anesthesia Emergence Delirium Scale,	Nurses	Various unspecified diseases	Surgery	Digital media (VG)	Self-directed

Hoffman et al. 2019, USA	Frontiers in Human Neuroscience	Clinical study using randomisation within subject design (pilot study)	Immersive Virtual Reality as an Adjunctive Non-opioid Analgesic for Pre-dominantly Latin American Children With Large Severe Burn Wounds During Burn Wound Cleaning in the Intensive Care Unit: a Pilot Study	To test whether immersive virtual reality (VR) can serve as an adjunctive non-opioid analgesic for children with large severe burn wounds during burn wound cleaning in the ICU	48	48 (their own controls)	6 to 17	A new portable water-friendly VR system customized for the unique needs of pediatric patients with large severe burn injuries during wound care in the intensive care unit hydrotank. During VR, patients played SnowWorld, an interactive 3D snowy canyon in virtual reality during some portions of wound care, vs. No VR during comparable portions of the same wound care session.	Pain VR presence Satisfaction	GRS (pain) Purpose made (VR presence) Pusposemade (satisfaction)	Nurses Researchers	Burns (> 10 %)	Wound care incl debridement,	Digital media (VR)	Self-directed
Özkan & Polat, 2019, Turkey	Journal of PeriAnesthesia Nursing	Clinical study using randomisation	The Effect of Virtual Reality and Kaleidoscope on Pain and Anxiety Levels During Venipuncture in Children	To determine the effect of two different distractions on pain perceptions and anxiety during venipuncture in children.	139	46 vs. 46 vs. 43	4 to 10	Virtual reality vs kaleidoscope vs control	Anxiety Pain	Children's Fear Scale, VAS (pain) Wong-Baker Faces Pain	Nurses, Researchers	Not specified (no chronic diseases or fever) Children received a routine health checkup	Needle related (venipuncture)	Digital media (VR), toy	Self-directed
Walther-Larsen et al. 2019, Denmark	Hospital Pediatrics	Clinical study using randomisation	Immersive virtual reality for pediatric procedural pain: a randomized clinical trial	To investigate patient satisfaction and pain reduction by using a three-dimensional VR interactive game as a distraction	64	32 vs. 32	7 to 16	VR game distraction + standard care vs standard care (including topical numbing cream, positioning, and distraction by a specialized pain nurse)	Pain, satisfaction	VAS (pain) VAS (satisfaction)	Anesthesiologists, Nurses	Various (elective surgery mainly urologic-genital surgery)	Veouns cannulation	Digital media (VR)	Self-directed
Chen et al. 2020, Taiwan	Journal of Clinical Nursing	Clinical study using randomisation	Distraction using virtual reality for children during intravenous injections in an emergency department: a randomised trial	To determine whether the virtual reality as a distracting intervention could reduce pain and fear in school-age children receiving intravenous injections at an emergency department	136	68 vs. 68	7 to 12	Virtual reality vs standard care. VR apps that were age-appropriate, as recommended by the App Store. The four virtual environments (i.e., roller coasters, space exploration, a wildlife park and travel destinations)	Pain Fear Time required	Wong to Baker FACES Pain Rating Scale , Children's Fear Scale, time	Researchers	Emergency department	Intravenous injection	Digital media (VR)	Self-directed
Hashimoto et al. 2020, Japan	Journal of PeriAnesthesia Nursing	Clinical study using randomisation	Video Glasses Reduce Preoperative Anxiety Compared With Portable Multimedia Player in Children: a Randomized Controlled Trial	To determine the anxiolytic effect of VG compared with that of a portable multimedia player (PMP) during the preoperative period in children.	60	30 vs. 30	4 to 12	VG group vs portable digital video disc player rom their entry to the preanesthetic holding area to the end of anesthetic induction	Anxiety, satisfaction, surgery related outcomes	modified Yale Preoperative Anxiety Scale (mYPAS), NRS (satisfaction), emergence agitation, Pediatric Anesthesia Emergence Delirium (PAED) , and Four-Point Agitation Scale, adverse events	Anesthesiologists	Various: mainly Otorhinolaryngology, Ophthalmology and Plastic surgery/dermatology	Surgery	Digital media (VR)	Self-directed
Sharifpour et al. 2020, Iran	Counselling and Psychotherapy Research	Clinical study using randomisation	Effects of virtual reality therapy on perceived pain intensity, anxiety, catastrophising and self-efficacy among adolescents with cancer.	To investigate the effect of virtual reality therapy (VRT) on pain variables among 30 adolescents with cancer at the chemotherapy stage.	30	15 vs. 15	14 to 18	The experimental group underwent eight 30-min sessions of VRT once a week for 2 months. A VRT film was watched offline by the patients	Pain	McGill Pain Questionnaire (MPQ), pain anxiety symptoms scale (PASS), pain Catastrophizing Scale (PCS), Pain self-efficacy questionnaire (PSEQ)	Researchers, psychologists	Oncology (osteosarcoma, Ewing's sarcoma, brain tumours, ovarian cancer and skeletal muscle cancer)	Chemotherapy	Digital media (VR)	Self-directed
Gerçeker et al. 2020, Turkey	Journal of Clinical Nursing	Clinical study using randomisation	Effects of virtual reality on pain, fear and anxiety during blood draw in children aged 5 to 12 years old: A randomised controlled study	To evaluate the effects of two different VR methods on procedure-related pain, fear and anxiety of children aged 5 to 12 years old during blood draw	136	45 vs. 45 vs. 46	5 to 12	Two different VR groups (VR-Rollercoaster group and VR-Ocean Rift group) and a control group (no VR device used)	Pain, anxiety	Wong to Baker Faces Pain Rating Scale, Children's Anxiety Meter (CAM) Child Fear Scale	Nurses Researchers	Not reported (but no chronic or genetic diseases)	Blood draw	Digital media (VR)	Self-directed

	Jung et al. 2020, USA	Pediatric Anesthesiology	Clinical study using randomisation	Pediatric Distraction on Induction of Anesthesia With Virtual Reality and Perioperative Anxiolysis: a Randomized Controlled Trial	To determine whether immersive audiovisual distraction with a VR headset during induction of general anesthesia (GA) in pediatric patients reduced preoperative anxiety	71	33 vs. 37	5 to 12	Patients in the VR group received audiovisual distraction with a VR headset during inhaled mask induction of GA in the operating room. The No VR group served as the control group and received standard medical care without any audiovisual devices.	Anxiety, Induction compliance, satisfaction	Modified Yale Preoperative Anxiety Scale (mYPAS), Induction compliance checklist (ICC), satisfaction questionnaire	Anesthesiologists	Various surgery	Surgery	Digital media (VR)	Self-directed
	Khadra et al. 2020, Canada	Burns	Clinical study using randomisation within subject design	Effects of a projector-based hybrid virtual reality on pain in young children with burn injuries during hydrotherapy sessions: a within-subject randomized crossover trial	To examine the effect of a water-friendly Projector-Based Hybrid Virtual Reality (VR) dome environment combined with standard pharmacological treatment on pain in young children undergoing burn wound care in hydrotherapy.	38	38 (cross-over)	0.5 to 7	The VR game, Bubbles an interactive pseudo-3D projector dome VR videogame vs standard pharmacological treatment	Pain, comfort, sedation	Face, Legs, Activity, Cry and Consolability scale, + (nurse proxy NRS), comfort level for child burn victims (OCCEBBECCO), Level of sedation	Nurses, physiotherapists, physician, portor,	Surgical diseases, burns	Hydrotherapy session	Digital media (VR)	Self-directed
	Wong et al. 2020, Hong Kong	Cancer Nursing	Clinical study using randomisation	Virtual Reality Intervention Targeting Pain and Anxiety Among Pediatric Cancer Patients Undergoing Peripheral Intravenous Cannulation: a Randomized Controlled Trial	To determine whether virtual reality distraction intervention can alleviate pain and anxiety and reduce length of procedure among pediatric cancer patients undergoing PIC	108	54 vs. 54	6 to 17	VR intervention was offered to patients 5 minutes before and during PIC.	Pain, anxiety	VAS (pain) State Anxiety Scale, pulse rate, duration	Nurses, Research assistant	Oncology	Needle-related (Peripheral intravenous cannulation)	Digital media (VR)	Self-directed
Procedures and diagnostics (Preparation and support)	Scott et al. 2002, United Kingdom	European journal of oncology nursing	Audit	Minimising the use of sedation/anaesthesia in young children receiving radiotherapy through an effective play preparation programme	To examine the effectiveness of a play preparation programme on a paediatric oncology unit within a regional radiotherapy centre.	63	No comparator group	2 to 5	Play preparation programme	Use of sedation	No specific tools were used	Play specialist Unspecified healthcare professionals (multidisciplinary team)	Oncology, non-specified cancer	Radiotherapy	Child Life intervention	Facilitated
	Vagnoli et al. 2005, Italy	Pediatrics	Non-randomised clinical study	Clown doctors as a treatment for preoperative anxiety in children: a randomized, prospective study.	To investigate the effects of the presence of clowns on a child's preoperative anxiety during the induction of anesthesia and on the parent who accompanies him/her until he/she is asleep.	40	20 vs. 20	5 to 12	A clown group, in which children interacted with clowns before entering the OR and stayed with them and their parent throughout the anesthesia-induction process vs control group	Anxiety	Modified Yale Preoperative Anxiety Scale, State-Trait Anxiety Inventory, Questionnaire for Health Professionals, Clown Effectiveness Self-Evaluation Form	Hospital clownUnspecified healthcare professionals	Surgical diseases, not specified (minor day surgery)	Surgery	Medical clown	Facilitated
	Li et al. 2007, China	Patient Education And Counseling	Clinical study using randomisation	Psychoeducational preparation of children for surgery: The importance of parental involvement.	To examine the effects of therapeutic play intervention on outcomes of children undergoing day surgery, and to highlight the importance of parental involvement in the psychoeducational preparation of children for surgery	203	97/106	7 to 12	A tour in the hospital (in groups of 5 children and one parent) and a doll demonstratuion 1 week before surgery	Child and parental anxiety, parents satisfactory level, child postoperative pain	Chinese version of the state anxiety scale for children (CSAS-C), post-operative parents' satisfaction questionnaire (PPSQ), visual analogue scale (VAS) for post operative pain level	Nurses	Surgical diseases, such as circumcision, herniorrhaphy, eye operation, ENT operation, dental operation, orthopaedic operation	Elective day surgery/GA	Medical play	Facilitated

Hallowell et al. 2008, Australia	Pediatric Radiology	Intervention study with no comparator group	Reviewing the process of preparing children for MRI.	To determine the effectiveness of a Practice MRI service in helping children cope with diagnostic MRI and to reduce the requirement for GA	291	No comparator group	3 to 7	A practice MRI intervention (PMRI) session conducted by an educational play therapist (EPT). The child experienced the scan environment and to hear the sounds of the unit. Training of relaxation, controlled breathing and guided imagery	Succesful PMRI session	Pass = Able to stay still in PMRI for >5 minutes	Play specialists Doctors (peadiatric radiologists)	Not specified	MRI	Play specialist intervention, play scanner	Facilitated
Golan et al. 2009, Israel	Pediatric Anesthesia	Clinical study using randomisation	Clowns for the prevention of preoperative anxiety in children: a randomized controlled trial	To determine if specially trained professional clowns allayed preoperative anxiety and resulted in a smooth anesthetic induction compared to the use of midazolam or no intervention.	65	22 vs. 22 vs. 21	3 to 8	Group 1 did not receive midazolam or clown presence Group 2 received oral midazolam 30 min before surgery Group 3 had two specially trained clowns present upon arrival to the preoperative holding area and throughout operating room (OR) entrance and mask application for inhalation induction of anesthesia	Anxiety	Video-tape at three time points (preoperative holding area, entrance to the OR, and during application of the anesthesia mask.) modified-Yale Preoperative Anxiety Scale STAI-test (parents' anxiety)	Hospital clown Research assistants (trained evaluators)	Surgical diseases, not specified	Surgery/GA (Elective outpatient surgery)	Medical clown	Facilitated
Fernandes & Arriaga 2010, Portugal	Journal of Health Psychology	Non-randomised clinical study	The effects of clown intervention on worries and emotional responses in children undergoing surgery.	To investigate if children in the clown group will report being less worried about the surgery; will express a more positive emotional state (higher positive affect), and will feel calmer when compared with children in the group without clowns	70	35 vs. 35	5 to 12	Clowns: The clowns arrived at the ambulatory room about 30 minutes before the child went to the operating room, staying 15 minutes with the child. The clowns used different methods of entertainment, adapted to the child's age, which included magic tricks, music, jokes, games, and the indispensable humor that characterizes them.	Worries about surgery, Preoperative valence, Preoperative arousal, Parents anxiety, Staff opinion	Child SurgeryWorries Questionnaire (CSWQ), Self Assessment Mannequin (SAM), State-Trait Anxiety Inventory to Form Y, EAS Temperament Survey for Children: Parental Ratings, questionnaire to ascertain the opinion of the healthcare professionals relative to the effectiveness of clowns	Nurses Hospital clown	Surgical diseases, various minor surgical diseases (the most were circumcision, herniorrhaphy, excision, orchiopexy and cystoscopy)	Surgery (minor)	Medical clown	Facilitated
Vagnoli et al. 2010, Italy	Pediatric Anesthesia	Clinical study using randomisation	Parental presence, clowns or sedative premedication to treat preoperative anxiety in children: what could be the most promising option?	To determine whether the presence of clowns was more effective in reducing preoperative anxiety in the child than sedative premedication (with midazolam) or only parental presence during induction of anesthesia (PPIA). As a secondary end point, we aimed at identifying the difference in the levels of parents' anxiety in the three groups.	75	25 vs. 25 vs. 25	5 to 12	Clown group (CG). Children were accompanied in the preoperative room by two clowns and a parent. Premedication group (PG). Children were premedicated with parents present, Control group (CG). Children were accompanied in the OR by one parent, without any clowns, other distractions, or premedications	Anxiety	The Modified Yale Preoperative Anxiety Scale (m-YPAS), The State-Trait Anxiety Inventory (STAI)	Nurses Hospital clown	Surgical diseases, minor surgical diseases such as phimosis, adenoids, strabismus, hydrocele, reflux etc.	Surgery/GA	Medical clowns	Facilitated

Tanaka et al. 2011, Japan	Journal of Pediatric Gastroenterology and Nutrition	Clinical study using randomisation	Evaluations of psychological preparation for children undergoing endoscopy	To provide psychological preparation to children who were hospitalized for endoscopy	20	4 vs. 6 vs. 10	4 to 15	Group 1: only the guidebook on endoscopy, group 2: children had the opportunity to ask questions while reading the guidebook with their parents and the hospital play specialist, and who received no therapeutic play; and group 3: children received an explanation with the guidebook and played with the dolls and medical instruments.	Physiological/ biochemical evaluation, Action observation, Self-coping behavior evaluation	Blood pressure, heart rate, and levels of salivary chromogranin A (CgA), Action observation: the Children's Coping Strategies Checklist (CCSC), questionnaire	Play specialists	Gastroenterology, upper and lower gastrointestinal tract endoscopy	Endoscopy	Play specialist intervention	Facilitated
Vaezzadeh et al. 2011, Iran	Iranian Journal of Pediatrics	Clinical study using randomisation	The Effect of Performing Preoperative Preparation Program on School Age Children's Anxiety	To examine effects of performing preoperative preparation program on children's anxiety.	122	61 vs. 61	7 to 12	Therapeutic play: a preoperative tour visit to the operation room, a manikin demonstration by the researcher, and a return demonstration by the children on preoperative procedures (with the mother). The therapeutic play was standardized and lasted for 1 hour.	Anxiety	The Spielberger State Anxiety Scale for children (SSAS-c)	Researcher sPsychologistsDoctors (paediatricians)	Surgical diseases, such as herniorraphy, urogenital, abdominal mass, breast mass, non specific abdominal pain	Surgery/GA	Medical play	Facilitated
Tsai et al. 2013, Taiwan	Child's Nervous System	Quasi-randomised clinical study	Efficacy of therapeutic play for pediatric brain tumor patients during external beam radiotherapy.	To investigate the effects of therapeutic play (TP) in reducing anxiety for pediatric brain tumor patients treated by EBRT.	19	9 vs. 10	3 to 15	Therapeutic play: story-telling, role-playing, painting RT headfixing mask, rewards given, interaction with other families	Anxiety	The Beck Youth Anxiety Inventory, Faces Anxiety Scale, heart rate, salivary cortisol	Nurses Doctors (radiologists)	Oncology, brain tumours	Beam therapy	Medical play	Facilitated
Dionigi et al. 2014, Italy	Journal of Health Psychology	Clinical study using randomisation	Clown intervention to reduce preoperative anxiety in children and parents: a randomized controlled trial	To investigate whether a clown doctor intervention could reduce preoperative anxiety in children hospitalized for minor surgery and in their parents.	77	52 vs. 25	2 to 12	Interacting clown/parent present vs. only parent present	Anxiety	Modified Yale Preoperative Anxiety Scale State to Trait Anxiety Inventory X and Y (at arrival, after the child had received anaesthesia), Likert scale ranging	Hospital clown Psychologists	Surgical diseases, non-specified otolaryngologic surgery	Surgery/GA	Medical clown	Facilitated
Gao et al. 2014, China	International Journal of Nursing Sciences	Clinical study using randomisation	Effect of interesting games on relief of preoperative anxiety in preschool children	To evaluate the effect of interesting games on reducing preoperative anxiety and improving compliance with anaesthesia in children	59	29 vs. 30	3 to 6	Game in decorated anaesthesia induction room with engaged nurse vs. routine care and preparation	Anxiety Compliance	Modified Yale Preoperative Anxiety Scale Induction Compliance Checklist (ICC)	Nurses Doctors (anaesthesiologists)	Surgical diseases, various surgical diseases (oblique inguinal hernia repair, superficial tumour excision, cryptorchidopexy, underwent hypospadias repair)	Surgery/GA	Wall decorations, toys, books	Facilitated
Li et al. 2014a, China	Hong Kong Medical Journal	Clinical study using randomisation	Effect of therapeutic play on pre- and post-operative anxiety and emotional responses in Hong Kong Chinese children: a randomised controlled trial	To examine the effectiveness of therapeutic play intervention in preparing children undergoing elective surgery and assess the implementation potential of such intervention	108	51 vs. 57	7 to 12	Routine preoperative information preparation + therapeutic play vs. routine preoperative information preparation	Anxiety	Chinese version of the State Anxiety Scale for Children and Adults at three time points Children's Emotional Manifestation Scale Postoperative Parents' Satisfaction Questionnaire Semi-structured interview	Nurses Doctors (anaesthesiologists)	Surgical diseases, not specified	Surgery/GA	Therapeutic play	Facilitated

Messina et al. 2014, Italy	Medical and surgical pediatrics	Non-randomised clinical study	Preoperative distraction in children: hand-held videogames vs clown therapy.	The aim of our study was to evaluate the efficacy of clown-therapy during the child's hospital stay, with a view to optimizing treatment and care, preventing behavioural alterations and enhancing the child's overall life quality.	885	444 vs. 441	5 to 12	Clown therapy vs. Hand-held video games.	Anxiety	Modified Yale Preoperative Anxiety Scale (m-YPAS), All the patients were evaluated in 2 different moment: in the waiting room, 10 minutes before the surgery (T1) and at the induction (T2).	Hospital clown Nurses Doctors	Surgical diseases, not specified	Surgery/GA	Medical clown, digital media (VG)	Facilitated
Fernande, S. Arriaga, P. Estevens, F.	Health Communication	Clinical study using randomisation	Using an Educational Multimedia Application to Prepare Children for Outpatient Surgeries.	To test the impact of an educational multimedia intervention on the cognitive, emotional, and physiological responses of children undergoing surgery, as well as on parental state anxiety	90	30 vs. 30 vs. 30	8 to 12	Three different groups: an educational multimedia intervention (experimental group - "An Adventure at the Hospital"), an entertainment video game intervention (comparison group), and a control group (no intervention)	Preoperative worries, emotional response. physiological measures, parental anxiety	Child Surgery Worries Questionnaire (CSWQ), Self-Assessment Manikin, Omron R3 pulse monitor, State-Trait Anxiety Inventory to Form Y, EAS Temperament Survey for Children: Parental Ratings	Nurses	Surgical diseases, not specified	Surgery	Digital media (VG)	Facilitated
He et al. 2015b, Singapore		Clinical study using randomisation	Therapeutic play intervention on children's perioperative anxiety, negative emotional manifestation and postoperative pain: a randomized controlled trial.	To examine if therapeutic play intervention could reduce perioperative anxiety, negative emotional manifestation and postoperative pain in children undergoing inpatient elective surgery.	95	48 vs. 47	6 to 14	1h therapeutic play intervention and routine care vs. routine care	Children's perioperative anxiety, Emotional manifestitations, Pain	The State Anxiety Scale for Children, Children's Emotional Manifestation Scale, Numeric ration scale (pain)	Researchers (trained researcher, 1 day training from a colleague)	Surgical diseases, not specified	Surgery/GA	Therapeutic play	Facilitated
Hyland et al. 2015, Australia	Burns	Clinical study using randomisation	An assessment of early Child Life Therapy pain and anxiety management: A prospective randomised controlled trial.	To assess whether the presence of a CLTP (Child Life Therapist) during children's initial burns dressings was effective in reducing the level of pain and anxiety they experience compared to those children who do not have a CLTP present.	100	50 vs. 50	0 to 15	Children in the CLT group received pre-procedural age appropriate preparation, parental support and education, and age specific distraction techniques by a qualified CLTP, whom was dedicated to that child and their family preceding and throughout the procedure (use of music, toys, electronic devices, games, and bubbles)	Pain, anxiety, use of any sedation or pain relief during the procedure, lenght of procedure	Children's Hospital of Eastern Ontario Pain Scale (CHEOPS), Children's Fear Scale	NursesPlay specialists	Surgical diseases, burns	Burns dressing	Child Life intervention	Facilitated
Moore et al. 2015, USA	Journal of Pediatric Health Care	Quasi-randomised clinical study (pilot study)	The Effect of Directed Medical Play on Young Children's Pain and Distress During Burn Wound Care.	To investigate whether children between the ages of 3 and 7 years with burn injuries who receive directed medical play delivered by a child life specialist just before their first burn wound dressing change would (a) self-report less pain and (b) show fewer pain/distress behaviors than children who have standard burn wound care preparation provided by a burn clinic nurse (standard care).	21	12 vs. 9	3 to 7	Directed medical play provided by child life specialist	Pain, behavioural pain, parental satisfaction	State-Trait Anxiety Inventory, Faces Pain Scale (FPS), Face, Legs, Activity, Cry, Consolability scale (FLACC) "How did we do?" questionnaire	Nurses, child life specialist	Surgical diseases, burns	Dressing change	Medical play	Facilitated

Pontes et al. 2015, Brazil	Einstein	Quasi-randomised clinical study	Therapeutic play: preparing the child for the vaccine.	To identify behaviors of children during vaccination after preparation with an instructional therapeutic play; to compare these behaviors in children who were prepared and those who were not prepared	60	30 vs. 30	3 to 6	Instructional therapeutic play sessions were carried out individually, using a doll, disposable syringes, needles, cotton, and bandages for venal puncture. The researcher showed the procedure in the doll and asked the child to participate and repeat the procedure at the end of the role play.	Bahaviours	Data were collected by means of observation of the child during vaccination and interview with their legal guardians.	Researchers	Other, immunisation	Needle related procedures	Therapeutic play	Facilitated
Yun et al. 2015, South Korea	Journal of Pediatric Nursing	Quasi-randomised clinical study	Effects of a Clown-Nurse Educational Intervention on the Reduction of Postoperative Anxiety and Pain Among Preschool Children and Their Accompanying Parents in South Korea.	To determine the effects of clown to nurse educational interventions during the preoperative education process in day surgery and to measure its effect on both children's and parents' anxiety levels and children's post-operative pain.	50	23 vs. 27	3 to 9	The clown to nurse educational intervention involved the use of a clown to nurse who worked on a one-on-one basis with each child, approximately 1 hour before their surgery	Anxiety	Blood pressure, The State-Trait Anxiety Inventory, Faces Pain Rating Scale-revised (FPS-R), VAS	Nurses	Ophthalmology, strabismus	strabismus surgery	Nurse clown	Facilitated
Al-Yateem et al. 2016, United Arab Emirates, Jordan	Child: care, health and development	Clinical study using randomisation*	Play distraction versus pharmacological treatment to reduce anxiety levels in children undergoing day surgery: a randomized controlled non-inferiority trial	To explore the efficiency of storytelling, pictures and colouring activities as an anxiolytic intervention in comparison to the traditional pharmacological premedication technique in a non-inferiority study	168	84 vs. 84	3 to 8	Storytelling, pictures and colouring activities vs. the traditional pharmacological premedication.	Anxiety	Trained anesthesiologist: The modified Yale Preoperative Assessment Scale Parents: The State-Trait Anxiety Inventory for Children. Vital signs (HR, RR, BP) were also collected preoperatively during the induction period and during the recovery period.	Nurses Research assistents Doctors (anesthesiologist)	Surgical diseases, not specified	Surgery	Toys, books, colouring	Facilitated
Arriaga & Pacheco 2016, Portugal	International Journal of Emotional Education	Quasi-randomised clinical study	Effects of Clown Doctors on child and caregiver anxiety at the entrance to the surgery care unit and separation from caregivers	To analyze the impact of Clown Doctors on children's and caregiver's preoperative anxiety during the separation from the caregiver and entrance to the surgery care unit	88	44 vs. 44	4 to 12	Interaction with clown and accompanied by the caregiver vs. only accompanied by the caregiver (after pre-medication) Clown stayed with caregiver in the recovery room	Child anxiety Caregiver anxiety	Parents and psychologist: The modified Yale Preoperative Assessment Scale (child anxiety) Parents: State-Trait Anxiety Inventory, Form Y (caregiver anxiety)	Nurses Psychologists Hospital clown	Surgical diseases, not specified	Surgery	Medical clown	Facilitated
Barthi et al. 2016, India	Indian Journal of Pediatrics	Clinical study using randomisation	MRI Customized Play Therapy in Children Reduces the Need for Sedation - A Randomized Controlled Trial	To evaluate the effectiveness of an MRIspecific play therapy intervention on the need for sedation in young children.	79	40 vs. 39	4 to 10	Play therapy Three phases: 1) Familiarizing with scan (introduction, and mini-scanner) 2) Instruction, incl. exercise of being still, play 'statue' 3) 'Dry-runs' with doll/toy Total: 30-40 min vs. standard preparative instructions	Cooperation with procedure (if not during the first 20 min then the chuld was sedated) - both cases and controls	No scales were applied	Doctors (paediatricians) Others (trained social worker)	Not specified	MRI	Therapeutic play	Facilitated

Cuzzocrea et al. 2016, Italy	Journal of Child Health Care	Non-randomised clinical study	Psychologists in preoperative programmes for children undergoing surgery	To verify whether psychologists and game activities could reduce preoperative anxiety and promote compliance in paediatric patients	104	4 different groups (no information on number assigned to each group)	3 to 12	4 conditions of treatment: (1) contextual games (puppet theatre with playful introduction to important moments of hospitalization + play with medical intruments) and psychological accompaniment = complete intervention (2) only contextual games, (3) distracting activities, and (4) only psychological accompaniment.	Anxiety Compliance	Modified Yale Preoperative Anxiety Scale (mYPAS) Induction Compliance Checklist (ICC)	Nurses Psychologists	Surgical diseases, not specified	Surgery	Puppet theathre, medical play	Facilitated
da Silva et al. 2016, Brazil	Pediatric Nursing	Intervention study with no comparator group with mixed methods	Using Therapeutic Toys to Facilitate Venipuncture Procedure in Preschool Children.	To study the efficacy of therapeutic toys during venipuncture procedures in children ages 3 to 6 years in order to minimize their negative reactions.	10	No comparator group	3 to 6	Dolls and puppets were used to enact stories for the children according to their age.	Understanding Acceptance Coping with the procedure	Observation and questionnaires completed by the children's adult guardians	Nurses	Emergency medicine, not specified	Venipuncture	Toy dolls, puppets	Facilitated
Grissom et al. 2016, USA	Support Care Cancer	Retrospective clinical study	Play-based procedural preparation and support intervention for cranial radiation.	To examine the relationship between play-based procedural preparation and support intervention and use of sedation in children with central nervous system (CNS) tumors during radiation therapy. And to analyze the cost-effectiveness of the intervention compared to costs associated with daily sedation.	116	No comparator group	5 to 12	Developmentally appropriate play, education, preparation, and distraction provided by a certified child life specialist. (The total number and duration of all intervention sessions)	Position during radiation, total radiation treatment dose, average minutes of daily radiation treatment, number of days over which radiation was administered, and need for sedation during radiation treatment	Chart review	Child life specialists	Oncology, CNS tumours	Radiation	Child Life intervention	Facilitated
Hamlet et al. 2016, USA	Journal of Cardiovascular Magnetic Resonance	Clinical study using randomisation	An interactive videogame designed to improve respiratory navigator efficiency in children undergoing cardiovascular...	To test the hypothesis that navigator feedback using an interactive videogame during CMR would improve navigator efficiency and maintain image quality and strains in children.	50	30 vs. 20 recieved off-scanner training	8 to 18	A navigator feedback videogame (FG), called “Bubble Gulp”. The objective of the game was to control the fish’s vertical position, which was updated with each navigator pulse, so it would “gulp” bubbles and acquire points. To incentivize slow, stable breathing, point values increased as the fish spent more time within the green lines, instead of frequent short-duration breath-holds. 30 of the 50 enrolled participants were randomized into equal groups to either receive extensive off-scanner training or no off-scanner training prior to scanning; thus, the groups were referred to as ‘trained’ and ‘untrained.’	Navigator efficiency, Signal-to-noise ratio, heart rate, strain	DENSEanalysis, Navigator efficiency was defined as the ratio of the number of heartbeats for which image data were accepted to the total number of heart beats required to complete the image acquisition.	Doctors (radiologists)	Cardiology, not specified	Cardiovascular magnetic resonance	Digital media (VG)	Facilitated

Kocherov et al. 2016, Israel	Journal of Paediatrics and Child Health	Clinical study using randomisation	Medical clowns reduce pre-operative anxiety, post-operative pain and medical costs in children undergoing outpatient penile surgery: A randomised controlled trial.	To investigate prospectively the potential benefits of the participation of the medical clowns in the outpatient paediatric penile surgery programme.	80	40 vs. 40	2 to 16	In a clown group, children interacted with clowns before entering the operating room (OR) and stayed with them and their parent throughout the anaesthesia-induction process. The clowns used various methods for entertaining the child according to the child's age (e.g. magic tricks, gags, music, games, puppets, word games, soap bubbles, etc.). When the child was taken to the OR, the clowns accompanied the child and the parent to the OR and stayed there during anaesthesia induction till patient loss of consciousness	Anxiety, pain	Yale Preoperative Anxiety Scale Instrument (m-YPAS), observation of face and legs activity, cry, consolability (FLACC) scale (0 to 10 score range) for patients younger than 3 years old and Wong-Baker Faces scale for those who are older	Nurses Hospital clown	Surgical diseases, meatal stenosis	Surgery	Medical clown	Facilitated
Dehghan et al. 2017, Iran	Iranian Red Crescent Medical Journal	Clinical study using randomisation	The effectiveness of dramatic puppet and therapeutic play in anxiety reduction in children undergoing surgery: a randomized clinical trial	To compare the effects of dramatic puppet and therapeutic play on anxiety of children undergoing surgery	75	25 vs. 25 vs. 25	6 to 12	Three groups (dramatic puppet, therapeutic play, and control) facilitated by nurses	Anxiety	Rrevised Children's Manifest Anxiety Scale	Nurses	Surgical diseases, appendicitis	Surgery for appendicitis	Therapeutic play	Facilitated
Orhan & Yildiz 2017, Turkey	International Journal of Caring Sciences	Clinical study using randomisation*	The Effects of Pre-Intervention Training Provided Through Therapeutic Play on the Anxiety Of Pediatric Oncology Patients During Peripheral Catheterization	To determine the effect of pre-intervention training provided through therapeutic play on reducing the anxiety of pediatric oncology patients during peripheral catheterization.	40	20 vs. 20	8 to 12	Therapeutic play with Chemo Duck toy and a training booklet vs. standard preparation	Anxiety	State-Trait Anxiety Inventory for Children (STAIC) after the peripheral catheterization	Researchers Nurses	Oncology, non-specified cancer	Needle related	Medical play	Facilitated
Ryu et al. 2017, Sourh Korea	British Journal of Surgery	Clinical study using randomisation	Randomized clinical trial of immersive virtual reality tour of the operating theatre in children before anaesthesia.	To determine whether a preoperative VR tour could reduce preoperative anxiety in children.	69	34 vs. 35	4 to 10	The VR group watched a 4-min video showing Pororo, the famous little penguin, visiting the operating theatre and explaining what is in it. The VR tour was provided as a 360◦ movie that introduced and further explained the perioperative preparation process. The intervention was implemented by the anaesthetists from the research team in a separate empty room 1 h before going to theatre.	Anxiety	Yale Preoperative Anxiety Scale (m-YPAS), induction compliance checklist (ICC), procedural behaviour rating scale (PBRS)	Nurses (anaesthetists)	Surgical diseases, not specified	general anaesthesia or elective surgery	Digital media (VR)	Facilitated
Scheel et al. 2017, Germany	Klinische Padiatrie	Clinical study using randomisation (pilot study)	Clowns in Paediatric Surgery: less Anxiety and More Oxytocin? A Pilot Study	To evaluate the effects of clowns as members of the therapeutic team in a tertiary pediatric surgical unit by combined phychological and physiological assessment	31	17 vs. 14	4 to 13	Accompanied by clown to surgury or at ward rounds vs. no clown	Anxiety Emotion Worries well-being parents satisfaction Health professiona'	The State-Trait Anxiety Inventory at 3 time points Self-Assessment Manikin Child surgical worries questionnaire	Hospital clown Doctors Nurses	Surgical diseases, not specified	Surgical or stationary treatment	Medical clown	Facilitated

									accapetance clown effectiveness physiological assessment	Interview before discharge (well-being, parent's satisfaction) Questionnaire for Health Professionals Clown Effectiveness Self-Evaluation Form Saliva samples at 2 time points					
Carlsson & Henningsson 2018, Sweden	Journal of Pediatric Nursing	Clinical study using randomisation	Visiting the Operating Theatre Before Surgery Did Not Reduce the Anxiety in Children and Their Attendant Parent.	To evaluate if (1). A preoperative visit to the operating theatre would attenuate the anxiety of the child on the day of surgery. (2). A preoperative visit to the operating theatre would attenuate the anxiety of the parent on the day of surgery.	62	31 vs. 31	3 to 12	45 min on a Wednesday afternoon one or two weeks before surgery: Tour starting at the preoperative apartment, the waiting room and then to a fully equipped operating room. Info, demonstyrations, try on dolls.	Anxiety	STAI-t m-YPAS (anxiety scores)	Nurses (incl. anaesthetist) Researchers	Surgical diseases, not specified	Surgery	Medical play	Facilitated
Coşkuntürk & Gözen 2018, Turkey	Journal of PeriAnesthesia Nursing	Clinical study using randomisation	The Effect of Interactive Therapeutic Play Education Program on Anxiety Levels of Children Undergoing Cardiac Surgery and Their Mothers.	To determine the effect of Interactive Therapeutic Play Education Program applied in preparing pediatric cardiac patients for surgery on the postoperative anxiety levels of such children and their mothers.	43	23 vs. 20	6 to 12	Interactive Therapeutic Play Education Program vs. standard care.	Anxiety	The State-Trait Anxiety Inventory for Children (STAIC) Beck Anxiety Inventory (BAI) = a Likert-type self-assessment scale	Nurses Doctors (anaesthesiologists) Researchers	Cardiology, congenital heart disease	Surgery (for cognital heart disease)	Digital media (VG)	Facilitated
Huntington et al. 2018, United Kingdom	Pediatric Anesthesia	Clinical study using randomisation	On-line preparatory information for children and their families undergoing dental ext...	To compare www.scottga.org to 2 controls: (i) standard care and (ii) a placebo video game, in terms of child behavior and anxiety; family satisfaction and reduction in induction and discharge times	176	60 vs. 59 vs. 55	5 to 7	www.scottga.org has 22 screens that families interact with by “mouse-clicking” and contains a cartoon “story,” 2 videos which model appropriate behavior and teach coping skills to access it approximately 1 week before the operation and given again on the ward on arrival for the surgery. The standard-care group received a pack with fasting and wound care instruction plus a coloring book (about healthy food choices). The placebo-video group received the same standard care materials plus access information to a hand-washing video	Anxiety, child behaviour, family satisfaction, induction time, discharge time	Facial Image Scale, induction behavior (visual analog scale), induction anxiety (modified Yale Preoperative Anxiety Scale, induction was video recorded, Satisfaction (VAS+Treatment Evaluation Inventory)	Nurses Others (paediatric dentists)	Surgical diseases, tooth extraction	General anesthesia (dental extraction)	Digital media (webpage with online material)	Facilitated
Liu et al. 2018, China	British Journal of Anaesthesia	Clinical study using randomisation	The effectiveness of transport in a toy car for reducing preoperative anxiety in preschool children: a randomised controlled prospective trial	To determine whether transport of a paediatric inpatient in a children’s ride-on toy car has an effect on perioperative levels of anxiety compared with transport on a hospital gurney with or without oral midazolam premedication.	108	36 vs. 36 vs. 36 (34 vs. 34 vs. 34)	2 to 5	Group 1: Transport in a children’s ride-on car vs. Group 2: Transport on a gurney without premedication vs. Group 3: Transport on a gurney and received premedication of oral midazolam	Anxiety	Preoperative interviews (emotionality, activity, sociability, and impulsivity (EASI)) The modified Yale Preoperative Anxiety Scale-Short Form, assessed at 6 time points, and parent-recorded anxiety VAS-C, assessed	Doctors (anaesthesiologists) Unspecified health care professionals Nurses? Portors?	Cardiology, congenital heart disease	Surgery	Ride-on car	Facilitated

										a 4 time points (before separation). Parental anxiety, VAS-P, was also determined				
Nasir et al. 2018, Parkistan	Medical forum monthly	Clinical study using randomisation*	Play distraction versus pharmacological treatment to reduce anxiety levels in children undergoing day surgery	To determine the effects of pictures, story telling and coloring books in reducing anxiety in pediatric patients preoperatively as compared to pharmacologic interventions	240	120 vs. 120	3 to 8	In the experiment group, a story was made for the children regarding their surgery and they were taken to the theatre in order to distractthem with colors and pictures. Different personnel and procedures were introduced in a playful manner for their familiarization with the surgical procedures. The parents of patients were handed a story and requested to tell that story to their child one hour prior to entering the theatre for surgery according to their child's taste and likings. Coloring books were given to the children and scenes from an operation theatre were depicted in it vs oral Midazolam thirty minutes prior to the surgery in the control group	Anxiety	Modified Yale Preoperative Assessment Scale (mYPAS), State to Trait Anxiety Inventory for Children(STAIC), blood pressure, heart rate, respiratory rate	Nurses	Surgical diseases, not specified	Elective day surgery	Pictures, story telling, and coloring books	Facilitated
Nir et al. 2018, Israel	Pediatric Pulmonology	Clinical study using randomisation	The effect of medical clowns on performance of spirometry among preschool aged children	To evaluate the ability of MCs to assist preschoolers in performing spirometry.	140	70 vs. 70	3 to 6	Second spirometry with a MC vs. second spirometry with a technician	Primary outcome: Second spirometry values compared between the groups. Secondary outcome: Change in spirometry values within groups, and difference between the groups.	Spirometry (reviewed by a pediatric pulmonologist).	Hospital clown Doctors (pediatric pulmonologists)Others (technicians)	Pulmonology, respiratory diseases	Spirometry	Medical clowns	Facilitated
Ryu et al. 2018, South Korea	Journal of clinical medicine	Clinical study using randomisation	The effect of gamification through a virtual reality on preoperative anxiety in pediatric patients undergoing general anesthesia: a prospective, randomized, and controlled trial	To evaluate whether gamification of the preoperative process—via virtual reality (VR) gaming that provides a vivid, immersive and realistic experience—could reduce preoperative anxiety in children	69	34 vs. 35	4 to 10	5 min VR game experiencing the preoperative experience vs. standard preoperative education	preoperative anxiety	Baseline modified Yale Preoperative Anxiety Scale (m-YPAS) Preoperative anxiety, induction compliance checklist (ICC) Procedural behavior rating scale (PBRS) were measured.	Nurses Doctors (anaestesiologists)	Surgical diseses, otolaryngeal, opthalmic, dental and other conditions requiring elective surgery	Elective surgery under GA	Digital media (VR)	Facilitated

Wong et al. 2018, Hong Kong	BMJ Open	Clinical study using randomisation	Effects of therapeutic play on children undergoing cast-removal procedures: a randomised controlled trial	To examine (1) the effectiveness of therapeutic play in reducing anxiety and negative emotional manifestations among children undergoing cast-removal procedures and (2) the satisfaction of parents and cast technicians with cast-removal procedures.	208	103 vs. 105	3 to 12	Preparation play was conducted before the CR procedure. A demonstration of the CR procedure was conducted using a doll. Throughout the CR procedure, support was given to children by introducing distraction play. The aim of the distraction play was to divert children's attention away from the medical procedure. Methods of distraction included visual or auditory distraction, deep breathing exercises, tactile stimulation, counting/singing or other verbal interaction. The duration of intervention was about 30 min.	Anxiety, emotional behavior, satisfaction	VAS (anxiety), Chinese version of the State Anxiety Scale for Children (CSAS-C), Children's Emotional Manifestation Scale (CEMS), heart rate	Nurses Play specialists	Surgical diseases, orthopaedic injury	cast-removal	Play specialist intervention	Facilitated
Kumar 2019, India	Journal of cardiothoracic and vascular anesthesia	Clinical study using randomisation	Perioperative Anxiety and Stress in Children Undergoing Congenital Cardiac Surgery and Their Parents: effect of Brief Intervention - A Randomized Control Trial	To know the effects of psychological preparation on perioperative stress, anxiety, and mood in children undergoing cardiac surgery and their parents.	60	30 vs. 30	5 to 15	Toys and videogames before surgery vs. standard care	Perioperative stress Anxiety Mood	Children: STAI-C before/after surgery, Ottawa mood and Ottawa stress scales, and Wong-Baker faces pain scale, serum cortisol Parents: STAI before/after surgery, Ottawa mood scale, Index of Clinical Stress (ICS) scale by Abell	Doctors (anesthesiologists)	Cardiology, congenital heart malformations (ASD, VSD, TOF, other)	Elective cardiac surgery	Digital media (VG) and toys	Facilitated
Reynolds et al. 2019, United Kingdom	International Journal of Paediatric Dentistry	Intervention study with no comparator group	How families prepare their children for tooth extraction under general anaesthesia: Family and clinical predictors of non-compliance with a 'serious game'	To explore family and clinical factors for usage of an online serious game designed to prepare children with ECC for dental treatment under general anaesthesia.	60	No comparator group	5 to 7	www.scottga.org has 22 screens that families interact with by "mouse-clicking" and contains a cartoon "story," 2 videos which model appropriate behavior and teach coping skills. They were prompted via e-mail to access it approximately 1 week before the operation and child/parents were given it again on the ward on arrival for the surgery.	Usage, family profile	Slides visited, games run	Dentists	Surgical diseases, tooth extraction	General anesthesia (dental extraction)	Webpage with online material/information/videos	Facilitated
Ryu et al. 2019, South Korea	Paediatric Anaesthesia	Clinical study using randomisation	The effect of an immersive virtual reality tour of the operating theater on emergence delirium in children undergoing general anesthesia: a randomized controlled trial	To determine whether apreoperative immersive virtual reality tour demonstrates a reduction in emergence delirium through reducing the preoperative anxiety in children undergoing general anesthesia	86	43 vs. 43	4 to 10	VR preparation vs. standard preoperative education	Emergence delirium (ED), preoperative anxiety scores and postoperative behavior disturbances.	Incidence and degree of ED using the Pediatric Anesthesia Emergence Delirium (PAED) scale as a diagnostic tool Preoperative anxiey: m-YPAS Post-Hospitalization Behavior Questionnaire for Ambulatory Surgery	Nurses Doctors (anaestesiologists)	Surgical diseases, not specified	Elective surgery in GA	Digital media (VR)	Facilitated

Chaurasia et al. 2019, India	Pediatric Anesthesiology	Clinical study using randomisation	Incentive-Based Game for Allaying Preoperative Anxiety in Children: a Prospective, Randomized Trial	To evaluate the efficacy of incentive-based game therapy in conjunction with parental involvement in reducing preoperative anxiety in children undergoing elective surgery under general anesthesia.	80	40 vs. 40	4 to 8	In the intervention group, the children and their parents were shown the anesthesia circuit and mask in the preoperative area. The children were taught how to blow through the mask to inflate the balloon. As per the game, a similar anesthesia circuit was handed over inside the operation theater, and the child who was able to blow through the mask for the longest period counting 1, 2, 3, 4… was declared the winner vs. standard of care.	Anxiety	Modified Yale Preoperative Anxiety Scale (mYPAS) Induction Compliance Checklist (ICC)	Unspecified health professionals	Various unspecified diseases (Reason for surgery: Ophthalmological, General surgery, Urological Orthopedic)	Surgery	Medical play	Facilitated
Eijlers et al. 2019, The Netherlands	European Journal of Anaesthesiology	Clinical study using randomisation	Virtual reality exposure before elective day care surgery to reduce anxiety and pain in children: a randomised controlled trial	To investigate if virtual reality exposure (VRE) as a preparation tool for elective day care surgery in children is associated with lower levels of anxiety, pain and emergence delirium compared with a control group receiving care as usual (CAU).	200	100 vs. 100	4 to 12	VRE tool encompasses a highly realistic virtual environment that is modelled according to the real operating theatre and medical staff	Anxiety, pain, delirium.	mYPAS, VAS (anxiety), FPS-R, FLACC, Child Behaviour Checklist (CBCL), Paediatric Anaesthesia Emergency Delirium (PAED). Measured at 5 time points	Nurses Researchers	Various diseases	Surgery	Digital media (VR)	Facilitated
Han et al. 2019, South Korea	JAMA Pediatrics	Clinical study using randomisation	Effect of Immersive Virtual Reality Education before Chest Radiography on Anxiety and Distress among Pediatric Patients: a Randomized Clinical Trial	To evaluate whether virtual reality education for pediatric patients before chest radiography could reduce anxiety and distress in children and improve the radiographic process.	100	50 vs. 50	4 to 8	The VR experience was provided as a 360°, 3-dimensional virtual environment that introduced and explained the process of chest radiography. All equipment and machines of the radiography room were measured, and 3-dimensional rendering was performed with graphic work. The script of the VR video on the radiographic process was written by radiology technologists and anesthesiologists and was revised by the pediatric psychiatrist vs standard care	Distress Satisfaction	Observational Scale of Behavioral Distress (OSBD) NRS (satisfaction)	Researchers, radiology technologists anesthesiologists	respiratory and/or cardiovascular symptoms	Chest radiography	Digital media (VR)	Facilitated
Moosavi et al. 2019, Iran	Journal of Client-Centered Nursing Care	Clinical study using randomisation	The Effect of Medical-Directed Play on the Severity of Pediatric Pain During Burn Dressing Change in Children: A Clinical Randomized Trial.	To investigate the effect of Medical directed play on the severity of pediatric pain during burn dressing change.	82	41 vs. 41	3 to 6	The game was initiated by the researcher before dressing for 15 minutes as follows: first, all the dressing steps were explained for the child and conducted on a doll with a burn. A child's dressing package was also provided to the subjects. The child helped removing the previous dressing and re-dressing the doll using children's	Pain	FLACC, pulse oxygen saturation	Researchers	Burns	Burn dressing change	Medical play	Facilitated

								medical tools vs standard care						
Park et al. 2019, South Korea	IEEE JOURNAL OF BIOMEDICAL AND HEALTH INFORMATICS	Clinical study using randomisation	The Effect of Mirroring Display of Virtual Reality Tour of the Operating Theatre on Preoperative Anxiety: a Randomized Controlled Trial	To determine whether parental co-experience of preoperative VR tour through a mirroring display could further reduce preoperative anxiety	80	40 vs. 40	4 to 10	VR tour prior to surgery with parents watching the same tour vs only children watching	Anxiety, compliance	mYPAS, induction compliance checklist (ICC)	Anesthesiologist	Various (elective surgery)	Surgery	Digital media (VR)	Facilitated
Matthyssens et al. 2020, Belgium	Journal of Pediatric Surgery	Clinical study using randomisation (pilot study)	A pilot study of the effectiveness of a serious game CliniPup® on perioperative anxiety and pain in children	To evaluate the effectiveness of the serious game CliniPup® on anxiety and pain in children undergoing ambulatory surgery.	72	25 vs. 22 vs. 25	5 to 11	A (CliniPup®), B ("Empty game" without educational information), or C (no game, oral information at the outpatient clinic, current standard of care)	Anxiety, pain, behaviour	VAS (anxiety) VAS (pain) Post-Hospitalization Behaviour Questionnaire for Ambulatory Surgery (PHBQ-AS)	Researchers	Various: general surgery, dentistry, otorhinolaryngology, urology	Surgery	Digital media (VG)	Facilitated
Scott et al. 2016, USA	International Journal of Radiation Oncology	Retrospective clinical study	Reducing Anesthesia and Health Care Cost Through Utilization of Child Life Specialists in Pediatric Radiation Oncology	To analyze the effectiveness of a certified child life specialist (CCLS) in reducing the frequency of daily anesthesia at our institution, and to quantify the potential health care payer cost savings of CCLS utilization in the United States.	425	304 vs. 121	3 to 12	Child life intervention: preparation, medical play, rehersal, procedural support.	Anesthesia	Anesthesia use (y/n)	Child Life Specialists	onc	Radiation therapy	Child Life intervention	Facilitated
Murang et al. 2017, USA	Journal of Pediatric Nursing	Retrospective clinical study	The Effects of Child Life Specialists on Success Rates of Intravenous Cannulation	To determine the impact of interventions by CLS upon successful attainment of intravenous (IV) cannulation among pediatric patients in the emergency department setting.	5460	240 vs. 5220	mean 6.4 and 7.0	CLS involve play and developmentally appropriate interventions to educate the children and the family on the medical event and procedure, plan and rehearse useful coping mechanisms and pain management strategies, and establish a therapeutic relationship between the family and the child	IVsucces IVattempts	No tools applied	Child Life Specialists	ed	IV cannulation	Child Life intervention	Facilitated
Hall et al. 2018, USA	Pediatric Emergency Care	Quasi-randomised clinical study	Certified Child Life Specialists Lessen Emotional Distress of Children Undergoing Laceration Repair in the Emergency Department	To evaluate the impact of certified child life specialists (CCLSs) on the emotional responses of children undergoing laceration repair in the emergency department (ED).	201	103 vs. 98	4 to 12	Child life intervention in ED	Emotions	Children's Emotional Manifestation Scale	Child Life Specialists	ED	Suture repair for lacerations	Child Life intervention	Facilitated
Elitsur et al. 2019, USA	Pediatric Rheumatology	Retrospective clinical study	Efficacy and cost savings with the use of a minimal sedation / anxiolysis protocol for intra-articular corticosteroid injections in children with juvenile idiopathic arthritis: a retrospective review of prospectively collected data	To evaluate the effectiveness and cost savings of a minimal sedation protocol for intra-articular corticosteroid injections in juvenile idiopathic arthritis patients after instituting this protocol at our institution.	80	No comparator group	2 to 18	Child life intervention: preparation and support during procedure	Pain Costs AdverseEvents	Verbal numeric rating scale (painVRS)	Child Life Specialists	rheuma, jia	Needle related (intra-articular corticosteroid injections)	Child Life intervention	Facilitated

	Hsiao et al. 2019, Taiwan	Pediatrics and Neonatology	Non-randomised clinical study	Psychosocial interventions for reduction of distress in children with leukemia during bone marrow aspiration and lumbar puncture	To assess the efficacy of psychosocial interventions to reduce distress in children with cancer undergoing BMA and LP in a pediatric cancer center in Taiwan.	18	7 vs. 11	3 to 11	Child life intervention: preparation and cognitive behavioral intervention (CBI)	Distress	Observational Scale of Behavioral Distress (OSBD-R)	Child Life Specialists	onc, leukemia	invasive procedures, bone marrow aspiration (BMA) and lumbar puncture (LP)	Child Life intervention	Facilitated
	Dwairej et al. 2020, Jordan	Journal for Specialists in Pediatric Nursing	Clinical study using randomisation	Video game distraction and anesthesia mask practice reduces children's preoperative anxiety: a randomized clinical trial	To evaluate the effectiveness of combined video game distraction and anesthesia mask exposure and shaping intervention as compared to conventional preoperative preparation on the preoperative anxiety, anesthesia induction compliance and emergence delirium of children undergoing day-case surgery.	128	64 vs. 64	5 to 11	The intervention group received combined interactive video distraction through the handheld video game and anesthesia mask exposure and shaping intervention. The control group received the usual care.	Anxiety, Induction compliance, Delirium	Modified Yale Preoperative Anxiety Scale (mYPAS), induction compliance checklist (ICC), Pediatric Anesthesia Emergence Delirium Scale	Nurses, anesthesiologists,	Various: Otolaryngology, dental, genital, orthopedic surgery	Surgery	Digital media (VG), medical guidance	Facilitated
Patient education (Knowledge, skills, and attitudes on disease and treatment)	Huss, 2003, USA	Journal of Pediatric Health Care	Clinical study using randomisation*	Computer Game for Inner-city Children Does Not Improve Asthma Outcomes	To evaluate the effects of a computer-assisted instructional (CAI) game on asthma symptoms (eg, coughing, wheezing, shortness of breath, and nighttime awakenings) in 7- to 12-year-old inner-city children over 12 weeks.	101	56 vs. 45	7 to 12	Computer-assisted instructional (CAI) game on asthma symptoms (eg, coughing, wheezing, shortness of breath, and nighttime awakenings)	Change in children's asthma symptoms	Juniper's Pediatric Asthma Quality of Life Questionnaire (PAQOL) and measurements of lung function	Not reported	Pulmonology, asthma	Medication adherence, avoidance of allergens	Digital media (VG)	Self-directed
	Kumar et al. 2004, USA	Diabetes Technology & Therapeutics	Clinical study using randomisation (pilot study)	The DAILY (Daily Automated Intensive Log for Youth) trial: a wireless, portable system to improve adherence and glycemic control in youth with diabetes	The primary objective of the DAILY (Daily Automated Intensive Log for Youth) trial was to assess the feasibility of utilizing a handheld personal digital assistant (PDA), equipped with a wireless modem, BG data management software, and the diabetes motivational game DiaBetNet, to assist in the outpatient management of youth with diabetes. The second objective was to increase adherence to BGM aimed at optimizing control.	40	19 vs. 21	8 to 18	Wireless modem and diabetes data management software, plus a wireless-enabled BG monitor	Feasibility of utilizing a handheld personal digital assistant Adherence to blood glucose monitoring	HbA1C, Diabetes Knowledge survey (adopted from the curriculum for adolescents and families published by the American Diabetes Association)	Not reported	Endocrinology, type 1 and 2 diabetes mellitus	Wireless-enabled blood glucose monitor	Digital media (VG)	Self-directed
	Shames et al. 2004, USA	Annals of Allergy, Asthma & Immunology	Clinical study using randomisation*	Effectiveness of a multicomponent self-management program in at-risk, school-aged children with asthma	To determine the effectiveness of an asthma education video game in reducing morbidity among high-risk, school-aged children with asthma.	119	59 vs. 60	5 to 12	Disease management program, including an educational video game.	Severity of asthma symptoms, use of medication, visits to urgent care units, knowledge scores for children and parents, Child Health Survey for Asthma (CHSA).	Asthma symptom diaries Peak flow measurements Spirometry Child Health Survey for Asthma (CHSA) Knowledge surveys for children and parents	Nurses Doctors (pediatric allergist/immunologist)	Pulmonology, asthma	No procedure	Digital media (VG)	Self-directed
	Kato & Beale 2006, USA	Journal of Pediatric Nursing	Intervention study with no comparator group with mixed methods (pilot study)	Factors affecting acceptability to young cancer patients of a psychoeducational video game about cancer.	To measure the initial acceptability of a proposed video game intended for adolescents and young adults with cancer and to assess whether acceptability is associated with user characteristics such as personality factors, adaptation style, video game experience, and demographic variables.	43	No comparator group	13 to 25	Participants were shown (1) a series of artist's drawings depicting video game characters and environments and/or (2) a 2-minute video game animation. They were then interviewed for 20 to 40 minutes regarding their preferences in relation to these materials (11 questions), their general video game preferences (15	Participants' use of video games generally and the acceptability of a game about cancer in particular.	Purpose-designed questionnaire (revised three times during the study), short form of the Weinberger Adjustment Inventory, NEO Five-Factor Inventory	Nurses	Oncology, various cancers such as ALL, Hodgkin's lymphoma , AML, brain tumour, non-Hodgkin's lymphoma and osteosarcoma.	No procedures	Digital media (VG)	Self-directed

								questions), and the informational needs of adolescents with cancer (3 questions).							
Beale et al. 2007, USA, Canada, Australia	Journal of Adolescent Health	Clinical study using randomisation*	Improvement in cancer-related knowledge following use of a psychoeducational video game for adolescents and young adults with cancer	To provide evidence for informed judgments about the specific effects of Re-Mission on cancer knowledge.	375	196 vs. 179	13 to 29	Re-Mission (HopeLab, Palo Alto, CA) is a video game designed to be played by young people undergoing treatment for cancer vs. regular video game (1 hour play/week for 3 months)	Cancer related knowledge Acceptability and credibility of Re-Mission	Questionnaires (0, 1, 3mo)	Researchers Unspecified health care professionals	Oncology, non-specified cancer	No procedures	Digital media (VG)	Self-directed
Kato et al. 2008, USA, Canada, Australia	Pediatrics	Clinical study using randomisation*	A video game improves behavioral outcomes in adolescents and young adults with cancer: a randomized trial.	To determine the effectiveness of a video-game intervention for improving adherence and other behavioral outcomes for adolescents and young adults with malignancies including acute leukemia, lymphoma, and soft-tissue sarcoma	375	196 vs. 179	13 to 29	Re-Mission (HopeLab, Palo Alto, CA) is a video game designed to be played by young people undergoing treatment for cancer vs. regular video game (1 hour play/week for 3 months)	Adherence to prescribed cancer treatment regimen, self efficacy to manage cancer, knowlegde about cancer, health locus of control, stress and quality of life	Questionnaires (0, 1, 3mo) , CDCI, MAS, Clinic Visit Attendance MEMS, Cancer knowlegde Scale, PQL-Generic Core Scale v.4, FACT-G, Multidimensional Health Locus of Control Scale Form C, Perceived Stress Scale, blood tests	Researchers Unspecified healthcare professionals	Oncology, various cancers such as ALL, Hodgkin's lymphoma , AML, brain tumour, non-Hodgkin's lymphoma, Ewing sarcoma and osteosarcoma.	No procedures	Digital media (VG)	Self-directed
Blanson Henkemans et al. 2013, The Netherlands	Patient Education and Counseling	Clinical study using randomisation (pilot study)	Using a robot to personalise health education for children with diabetes type 1: A pilot study	To assess the effects of personalised robot behaviours on the enjoyment and motivation of children with diabetes, and on their acquisition of health knowledge, in educational play	5	3 vs. 2	8 to 12	Diabetes quizzes against a personal or neutral robot on three occasions: once at the clinic (45 min), twice at home (2x30 min)	Diabetes knowledge Fun with the robot	Diabetes knowledge qustionnaire before and after intervention the MIND Youth Questionnaire Five-point Likert scale (fun with robot) wanting to play a fourth round (motiviation)	Doctors (diabetes paediatricians) Nurses Psychologists Others (dieticians)	Endocrinology, type 1 diabetes mellitus	No procedure	Digital media (robot)	Self-directed
Klingensmith et al. 2013, USA	Pediatric Diabetes	Intervention study with no comparator group (pilot study)*	Evaluation of a combined blood glucose monitoring and gaming system (Didget®) for motivation in children, adolescents, and young adults with type 1 diabetes	To assess the performance and acceptability of a blood glucose meter coupled with a gaming system for children, adolescents, and young adults with type 1 diabetes.	147	No comparator group	5 to 24	The Didget® system is based on the CONTOUR® blood glucose meter that allows for connection of the meter to Nintendo® game systems, including Nintendo DS® and Nintendo DS® Lite. Individuals are rewarded for performing up to four blood glucose tests per day that are at least 2 h apart. In addition to earning reward points for regular daily testing, children can earn bonus reward points for consistent testing habits over time (testing ≥3 times a day for 30, 60, and 90 d). HCPs can also set personalized target ranges in the Didget® meter to help patients reach glucose goals.	The primary end-point of this study was to evaluate the accuracy of the investigational Didget® system, Secondary end-points included precision, comprehension of instructional aterials, understanding of the system, ease of use, and product satisfaction.	International Organization for Standardization (ISO) guidelines (15) and by regression and error grid analysis vs. a YSI value in the in-clinic portion of this study. Subject and HCP evaluations were determined by written satisfaction surveys for both the in-clinic and home-use components and were recorded by the HCP.	Not reported	Endocrinology, type 1 diabetes mellitus	Blood glucose testing	Digital media (VG)	Self-directed

	Calle-Bustos et al. 2017, Spain	PLOS ONE	Intervention study with no comparator group	An augmented reality game to support therapeutic education for children with diabetes.	1) To develop an AR game to support Therapeutic education in diabetes for children. 2) To determine the effectiveness of the game in terms of learning, perceived satisfaction, and usability	70	No comparator group	5 to 14	AR game with information on diet and diabetes	Diabetes knowledge Satisfaction Usability	Pre-knowledge questionnaire and post-knowledge questionnaire on the knowledge of diabetes	Doctors Researchers	Endocrinology, diabetes	No procedure	Digital media (AR)	Self-directed
Treatment (Medical and surgical treatment)	Tanabe et al. 2002, USA	Journal of emergency nursing	Quasi-randomised clinical study	The effect of standard care, ibuprofen, and distraction on pain relief and patient satisfaction in children with musculoskeletal trauma.	To evaluate the effectiveness of nursing interventions in decreasing pain for children with minor musculoskeletal trauma and moderate painand to examine patient satisfaction.	76	26 vs. 24 vs. 26	7 to 17	(1) Standard care (ice, elevation, and immobilization) only vs. (2) standard care and ibuprofen vs. (3) standard care and distraction	Pain	Wong/Baker Faces scale	Nurses	Emergency Medicine, musculoskeletal trauma	No procedures	Toys, books, videos	Facilitated
	Herbison et al. 2013, United Kingdom	Eye	Intervention study with no comparator group (pilot study)	Interactive binocular treatment (I-BiT) for amblyopia: results of a pilot study of 3D shutter glasses system.	To report the effect of I-BiT treatment on visual acuity (VA) in children with amblyopia	10	No comparator group	4 to 8	30 min of I-BiT treatment once weekly for 6 weeks. Treatment sessions consisted of playing a computer game and watching a DVD through the I-BiT system.	visual acuity compliance safety	Proportion of planned treatment visits completed by each patient. Number and type of adverse events reported. Glasgow acuity test or the LogMAR crowded Kay's picture test.	Doctors (ophthalmologists) Unspecified health care professionals	Ophthalmology, amblyopia	No procedure	Digital media (VG or video)	Self-directed
	Shiri et al. 2013, Israel	Pain Medicine	Intervention study with no comparator group (pilot study)	A virtual reality system combined with biofeedback for treating pediatric chronic headache--a pilot study.	To test the hypothesis that the learning process of associating between their ability to relax and viewing themselves in a headache-free state would enhance the participating children's ability to better cope with their headache and its consequences	10	No comparator group	10 to 17	Virtual reality system, which simultaneously employs both biofeedback and positive images, similar to images suggested in guided imagery	Headache, Quality of Life, Users satisfaction	Visual Analogue Scale (VAS), Pediatric Quality of Life (PedsQL)	Not reported	Neurology, chronic headache	No procedure	Digital media (VR)	Self-directed
	Verbeken et al. 2013, Belgium	Behavior Research and Therapy	Clinical study using randomisation (pilot study)	Executive function training with game elements for obese children: a novel treatment to enhance self-regulatory abilities for weight-control.	To investigate the effects of an Executive Functioning (EF) training with game elements on weight loss maintenance in obese children, over and above the care as usual in an inpatient treatment program.	44	22 vs. 22	8 to 14	The intervention is a training of cognitive executive functioning embedded in a game-world. The game consists of 25 training sessions of about 40 min.	Treatment acceptability, weight control, working memory,	The Corsi Block-Tapping Task e forward and backward version, Behavior Rating Inventory of Executive Functioning [BRIEF], BMI	Not reported	Endocrinology, obesity	No procedure	Digital media (VG)	Self-directed
	Ullán et al. 2014, Spain	Pain Management Nursing	Clinical study using randomisation	The effect of a program to promote play to reduce children's post-surgical pain: with plush toys, it hurts less.	To determine the effect of a program to promote play in the hospital on postsurgical pain in pediatric patients.	95	48 vs. 47	1 to 7	(1) Information about the importance of distracting their children through play to relieve their distress and (2) play material to do so (a rabbit doctor)	Pain	FLACC scale.	Nurses	Surgical diseases, not specified	Surgery	Toys	Facilitated
	Brown et al. 2014, Australia	Burns	Clinical study using randomisation	Play and heal: randomized controlled trial of Ditto™ intervention efficacy on improving re-epithelialization in pediatric burns.	To investigate the effect of the Ditto™ (a hand-held electronic medical device providing procedural preparation and distraction) intervention on re-epithelialization rates in acute pediatric burns.	75	35 vs. 40	4 to 12	Ditto procedural preparation story of "Bobby gets a burn" whilst waiting for medication to take effect. During all wound care procedures they engaged in a choice of interactive stories or games as the distraction component of the Ditto intervention	Wound healing Pain Anxiety	Visitrak and (b) blinded review of photographs (wound healing). The Faces Pain Scale to Revised (FPS-R) (FLACC) scale. Heart rate, oxygen saturations, Visual Analog Scale-Anxiety (VAS-A) The Child Trauma Screening Questionnaire (CTSQ)[	Nurses Doctors (paediatricians)	Surgical diseases, burns	Wound dressing	Digital media (Ditto)	Self-directed

Li et al. 2014b, USA	Eye	Non-randomised clinical study	A binocular iPad treatment for amblyopic children	To ivestigate the effectiveness of a home-based binocular treatment for childhood amblyopia.	75	50 vs. 25	4 to 12	Binocular (50 children) and sham (25 children) iPad games. Each game was dichoptic, with low-contrast components visible to one eye and high-contrast components visible to the other eye.	Best-corrected amblyopic eye visual acuity (BCVA), Stereoacuity, Suppression, Compliance	E-ETDRS (for BCVA), Randot Preschool Stereoacuity Test, Stereo Butterfly Test, Lang-Stereotest I, dichoptic motion coherence test	Not reported	Ophthalmology, amblyopia	No procedure	Digital media (VG)	Self-directed
Mohan et al. 2015, India	Pain Management Nursing	Clinical study using randomisation	The Effect of Entonox, Play Therapy and a Combination on Pain Relief in Children: A Randomized Controlled Trial.	To evaluate the effects of Entonox, play therapy, and a combination to relieve procedural pain in children	123	31 vs. 32 vs. 30 vs. 30	4 to 15	Group A received Entonox, Group B received play therapy, Group C received both Entonox and play therapy, and Group D received existing standard interventions. Play therapy: distracted using cartoons, videogames, and puzzles, and the researcher explained the procedure in simple terms.	Pain	FLACC scale, Wong Bakers Faces Pain Scale	Nurses Play specialists	Surgical diseases, not specified	Painful procedure (not specified)	Play therapy	Facilitated
Dowler 2016, United Kingdom	Nursing children and young people	Intervention study with no comparator group with mixed methods	Can improvised somatic dance reduce acute pain for young people in hospital?	To assess whether improvised somatic dance can have a positive effect on children and young people experiencing acute pain.	25	No comparator group	1 to 17	Improvised somatic dance with dance artist, including playing with sensory objects, creating a story through imagination, or micro dance. An ending with rest and relaxation	Pain	Faces, Legs, Activity, Cry, Consolability (FLACC) scale, the Paediatric Pain Profile (PPP) and the Wong-Baker FACES Pain Rating Scale.	Others (dance artist)	Various diseases, i.e. acquired brain injury or cardiac or orthopaedic surgery	No procedure	Dance	Facilitated
Dadeya & Dangda, 2016, India	Strabismus	Clinical study using randomisation	Television Video Games in the Treatment of Amblyopia in Children Aged 4-7 Years	To investigate the role of television video games in childhood amblyopia treatment.	40	20 vs. 20	4 to 7	Action video game, along with patching (12 half-hour sessions each at weekly intervals) vs. patching alone	Best corrected visual acuity	Best corrected visual acuity (BCVA) (both distance and near) and stereoacuity measurements at 3, 6, 9, and 12 weeks.	Not reported	Ophthalmology, amblyopia	No procedure	Digital media (VG)	Self-directed
Herbison et al. 2016, United Kingdom	British Journal of Ophthalmology	Clinical study using randomisation*	Randomised controlled trial of video clips and interactive games to improve vision in children with amblyopia using the I-BiT system.	1. To determine the difference in visual acuity improvement in patients treated with I-BiT compared with non-I-BiT treatment. 2. To determine the difference in effectivity between the interactive games and DVDs.	75	24 vs. 26 vs. 25	4 to 8	DVD footage shown to the amblyopic eye and common background to both vs modified shooter game with sprite and targets presented to the amblyopic eye (and background to both). vs both background and foreground presented to both eyes (non-interactive binocular treatment	Change in visual acuity from week 1 (pretreatment) to week 6 (post-treatment) The secondary outcome measures included changes instereoacuity (Frisby test), and the safety, acceptability and compliance of treatment.	Visual Acuity with a LogMAR test	Doctors (ophthalmologists)	Ophthalmology, amblyopia	No procedure	Digital media (VG)	Self-directed
Holmes et al. 2016, USA	JAMA Ophthalmology	Clinical study using randomisation*	Effect of a Binocular iPad Game vs Part-time Patching in Children Aged 5 to 12 Years With Amblyopia: a Randomized Clinical Trial	To compare visual acuity (VA) improvement in children with amblyopia treated with a binocular iPad game vs part-time patching	385	190 vs. 195	5 to 13	Binocular iPad game or patching of the fellow eye.	Change in amblyopic-eye VA from baseline to 16 weeks.	Visual acuity was measured in each eye with optimal refractive correction (if applicable) and without cycloplegia by a study-certified examiner (masked at follow-up). Questionnares	Doctors (ophthalmologists)	Ophthalmology, amblyopia	No procedure	Digital media (VG)	Self-directed

Kelly et al. 2016, USA	JAMA Ophthalmology	Clinical study using randomisation within subject design	Binocular iPad Game vs Patching for Treatment of Amblyopia in Children - A Randomized Clinical Trial	To assess the effectiveness of a binocular iPad (Apple Inc) adventure game as amblyopia treatment and compare this binocular treatment with patching, the current standard of care.	28	28 (crossover)	4 to 9	Children were asked toplay the Ipad game at home for 1 hour a day 5 days a week for 2 weeks (10 hours total). During game play, children wore red-green anaglyphic glasses that separate game elements seen by each eye so that reduced-contrast elements (eg, gold and fire) are seen by the felloweye, high-contrast elements (eg, miners and monsters) are seen by the amblyopic eye, and high-contrast background elements (eg, ground and rocks) are seen by both eyes	Vision assessments	Best-Corrected Visual Acuity (BCVA) stereoacuity component, extent of suppression scotoma, depth of suppression	Doctors (ophthalmologists)	Ophthalmology, amblyopia	No procedure	Digital media (VG)	Self-directed
Webber et al. 2016, Australia	Investigative Ophthalmology & Visual Science	Non-randomised clinical study	Fine Motor Skills of Children With Amblyopia Improve Following Binocular Treatment	To determine whether reduced fine motor skills in children with amblyopia improve after binocular treatment and whether improvements are sustained once treatment has ceased.	30	20 vs. 10 matched healthy controls	7 to 12	iPod Dichoptic Game-Play: a modified version of the videogame Tetris, instructed to play the game for 1 hour per day, which could be completed in daily sessions of 1hour/ 5 days per week for 5 weeks.	Fine motor skills, visual acuity, level of binocular function	Bruininks-Oseretsky Test of Motor Proficiency, Early Treatment of Diabetic Retinopathy Study chart, Randot preschool stereoacuity, Worth 4 Dot	Doctors (ophthalmologists)	Ophthalmology, amblyopia	No procedure	Digital media (VG)	Self-directed
Singh et al. 2017, India	Journal of Pediatric Ophthalmology and Strabismus	Clinical study using randomisation	Evaluation of the Role of Monocular Video Game Play as an Adjuvant to Occlusion Therapy in the Management of Anisometropic Amblyopia.	To evaluate the role of monocular video game play as an adjuvant to occlusion therapy in the treatment of anisometropic amblyopia.	68	34 vs. 24	6 to 14	Children received occlusion therapy (6 hours per day) with video game play (1 hour per day). In the occlusion only group, the children received only occlusion therapy for 6 hours per day. Patients returned for follow-up at 1 and 3 months after treatment.	Visual acuity, contrast sensitivity,	Snellen and ETDRS charts, F.A.C.T. (Functional Acuity Contrast Test)	Doctors (ophalmologists)	Ophthalmology, amblyopia	No procedure	Digital media (VG)	Self-directed
Gao et al. 2018, New Zealand, Australia, China, Canada	JAMA Ophthalmology	Clinical study using randomisation*	Effectiveness of a binocular video game vs placebo video game for improving visual functions in older children, teenagers, and adults with amblyopia: a randomized clinical trial	To evaluate the effectiveness of a homebasedversion of a binocularvideogameagainst a placebo video game for improving visual functions in children 7 years and older and adults.	115	56 vs. 59	7< (54% of participts < 18)	Both the active and placebo treatments were falling-blocks video games on iPod Touch devices, viewed through redgreen anaglyphic glassesworn over appropriate refractive correction. The active video game presented different game elements to each eye.	Change in amblyopic eye visual acuity, compliance, stereoacuity, and interocular suppression.	Electronic Visual Acuity Tester, VAs at 40 cm, stereopsis, ocular alignment (cover test), angle of strabismus (prism alternate cover test), binocular sensory status (Worth 4 dot test), and interocular suppression, modified version of the Amblyopia Treatment Index questionnaire"	Doctors (ophthalmologists)	Ophthalmology, amblyopia	No procedure	Digital media (VG)	Self-directed
Manh et al. 2018, USA	American Journal of Ophthalmology,	Clinical study using randomisation*	A Randomized Trial of a Binocular iPad Game Versus Part-Time Patching in Children Aged 13 to 16 Years With Amblyopia.	To compare visual acuity (VA) improvement in teenagers with amblyopia treated with a binocular iPad game vs part-time patching.	100	40 vs. 60	13 to 16	16 weeks of home-based treatment with binocular game play on an iPad device prescribed for 1 hour a day vs. patching prescribed for 2 hours a day	Improvement in amblyopic eye VA	VA measuring	Doctors (ophthalmologists)	Ophthalmology, amblyopia	No procedure	Digital media (VG)	Self-directed
Holmes 2019, USA	Ophthalmology	Clinical study using	A Randomized Trial of Binocular Dig Rush Game	To compare visual acuity (VA) improvement in children aged 7 to 12 years with amblyopia	138	69 vs. 69	7 to 12	Binocular treatment (Dig Rush binocular game plus spectacle	Visual acuity	No specific scale	Doctors (ophthalmologists)	Ophthalmology, amblyopia	No procedure	Digital media (VG)	Self-directed

		randomisation*	Treatment for Amblyopia in Children Aged 7 to 12 Years	treated with a binocular iPad game plus continued spectacle correction vs. continued spectacle correction alone.				wear (if needed)) vs. Control (continued optical treatment)							
	Nieuwhof-Leppink et al. 2019, The Netherlands	Journal of Pediatric Urology	Non-randomised clinical study	Does a serious game increase intrinsic motivation in children receiving urotherapy?	To explore intrinsic motivation in children receiving bladder training for DUI and whether using a serious game improves their intrinsic motivation.	50	27 vs. 23	8 to 14	Bladder training with serious game (Ipad) vs. bladder training without game (pen and paper)	Intrinsic motivation Incontinence-related quality of life	Pediatric Incontinence Questionnaire Parental Motivation Inventory Intrinsic Motivation Inventory	Doctors (paediatricians) Nurses (uro-therapists)	Nephro/urology, daytime urinary incontinence	Urotherapy	Digital media (VG)	Self-directed
	Agrawal et al. 2019, USA	Pediatric Blood & Cancer	Intervention study with no comparator group (pilot study)	Virtual reality as complementary pain therapy in hospitalized patients with sickle cell disease.	To conduct a feasibility study of immersive VR therapy in patients hospitalized for vaso-occlusive pain. Secondarily, we hypothesized that a single VR session would improve the pain experience in this group.	30	No comparator group	8 < (mean 16)	15 minutes VR headset to explore an underwater world and interact with animals.	Simulator sickness, feasibility, pain	Adolescent pediatric pain tool (APPT), Simulator sickness Questionnaire, Satisfaction (Purpose made questionnaire)	Unspecified health professionals	Sickle cell disease	No procedure	Digital media (VR)	Self-directed
	Diaz-Hennessey et al. 2019	Pediatric Nursing	Quasi-randomised clinical study (pilot study)	Virtual Reality: Augmenting the Acute Pain Experience in Children	To determine the effect of virtual reality (VR) on acute pain in pediatric patients with sickle cell disease experiencing vasoocclusive crisis in one acute-care pediatric emergency department (ED).	15	7 vs. 8	8 to 17	VR for 15 minutes after they received their IV pain medication (standard care) vs SC only.	Pain	FLACC, NRS (pain)	Nurses	Sickle cell disease	No procedure	Digital media (VR)	Self-directed
	Yao et al. 2019	British Journal of Ophthalmology	Clinical study using randomisation	Binocular game versus part-time patching for treatment of anisometropic amblyopia in Chinese children: a randomised clinical trial	To compare amblyopic-eye visual acuity (VA) and binocularity improvement of a binocular game with parttime patching in the treatment of Chinese children with anisometropic amblyopia	103	36 vs. 38 vs. 29	3 to 13	Binocular video game vs patching vs combined The binocular group was prescribed 40 min of a binocular game a day and was divided into two training sessions. The patching group was prescribed 2 to 6 hours of patching of the fellow eye a day depending on the severity of amblyopia	Visual acuity	LogMAR Visual Acuity	Ophthalmologists	Ophthalmology, amblyopia	No procedure	Digital media (VG)	Self-directed
	Alonso-Prieto et al. 2020, Spain	Journal of Medical Internet Research	Non-randomised clinical study	The association between pain relief using video games and an increase in vagal tone in children with cancer: Analytic observational study with a quasi-experimental pre/posttest methodology	1) To assess the association between the use of EVGs and the intensity of pain caused by chemotherapy-induced mucositis in pediatric patients with cancer 2) To assess the association between changes in pain intensity and sympathetic-parasympathetic balance in this sample of pediatric patients.	19	19 (their own controls)	4 to 17	Play Station games on the patient's preference and age as follows (3 hours/day) vs no video game	Pain	NRS (pain) Pupil size Heart rate	Unspeficied health professionals	Oncology (pain secondary to mucositis in relation to cancer treatment)	No procedure	Digital media (VG)	Self-directed
	Lee et al. 2020, USA	Journal of Pediatric Ophthalmology and Strabismus	Clinical study using randomisation	Short-term perceptual learning game does not improve patching-resistant amblyopia in older children	To investigate self-administered, at-home use of a perceptual learning to based video game consisting of target detection of stimuli in different sizes, spatial frequency, orientation, and contrast as a potential dichoptic therapy to improve binocular function in amblyopic patients resistant to patching.	26	7 vs. 8 vs. 10	8 to 18	(1) binocular perceptual learning (20 min/day of video game played with polarized lens), (2) monocular perceptual learning (20 min/day of video game played with non-amblyopic eye patched), or (3) patching (2 hours/day)	Visual acuity	Visual acuity tests	Ophthalmologists	Amblyopia	No procedure	Digital media (VG)	Self-directed
Treatment (Rehabilitation and exercise)	Harris & Reid 2005, Canada	Canadian Journal of Occupational Therapy	Intervention study with no comparator group	The influence of virtual reality play on children's motivation	To explore the degree of motivation children exhibit during virtual reality (VR) play sessions	16	No comparator group	8 to 12	8 1-h VR game sessions + standard care (occ. and phys. therarpy 1-2/week) vs. standard care	Gross motor function	The Pediatric Volitional Questionnaire (PVQ)	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedures	Digital media (VR)	Facilitated
	Bryanton et al. 2006, Canada	CyberPsychology & Behavior	Non-randomised clinical study (pilot study)	Feasibility, motivation, and selective motor control: virtual reality compared	To investigate the efficacy of a virtual reality training session for motor rehabilitation	16	10 vs. 6	7 to 17	VR environment during training session vs. conventional training session	Fun and interest Movement kinetics	VAS	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedures	Digital media (VR)	Self-directed

			to conventional home exercise in children with cerebral palsy											
Widman et al. 2006, USA	The Journal of Spinal Cord Medicine	Intervention study with no comparator group	Effectiveness of an upper extremity exercise device integrated with computer gaming for aerobic training in adolescents with spinal cord dysfunction.	To (a) determine if the GameCycle requires sufficient effort, as outlined by the ACSM, to induce an aerobic training effect and (b) to assess the effectiveness, practicality, and satisfaction of the GameCycle as part of a 4-month, home-based exercise intervention for adolescents with lower extremity mobility impairments caused by spinal cord dysfunction.	8	No comparator group	14 to 18	GameCycle. The subjects were instructed to play the GameCycle at least 3 times per week, at least 20 minutes per session, for 16 weeks	Peak oxygen uptake, anaerobic threshold	Peak oxygen uptake and anaerobic threshold w. standard ramp protocol on a magnetically braked arm ergometer	Physical therapists / occupational therapists	Neurology, spina bifida	No procedures	Digital media (VG)	Self-directed
Sharar et al. 2007, USA	Archives of physical medicine and rehabilitation	Clinical study using randomisation within subject design	Factors influencing the efficacy of virtual reality distraction analgesia during postburn physical therapy: preliminary results from 3 ongoing studies.	To assess the efficacy and side effects of immersive virtual reality (VR) distraction analgesia, as well as patient factors associated with VR analgesic efficacy in burn patients who require passive range-of-motion (ROM) physical therapy (PT).	88	73 (their own control)	6 to 65y (75 % were 6 to 18)	VR Snow-World, subjects followed a predetermined path, “gliding” through an icy 3-dimensional virtual canyon during PROM excercises (plus analgesic as part of standard care). Max 15 minutes	Subjective assessment of pain, Time spend thinking about pain, (VR only: nausea, "realness", sence of presence)	100-mm graphic rating scales	Physical therapists / occupational therapists	Surgical diseases, burns	Passive range of motion physical therapy	Digital media (VR)	Self-directed
Heathcock et al. 2008, USA	Physical Therapy	Clinical study using randomisation	Movement training advances the emergence of reaching in infants born at less than 33 weeks of gestational age: a randomized clinical trial	(1) To compare the emergence of reaching in infants born full-term and infants born at less than 33 weeks of gestational age and (2) to evaluate the effectiveness of a movement training program on the emergence of reaching in this preterm population.	39	13 vs. 13 vs. 13	preterm (born <33 weeks gestional weight < 2500 g) + full to term	20 minutes of daily movement training (preterm) vs daily social training (preterm) vs social training (full-term)	Hand-Toy Contact Number, Hand-Toy Contact Duration, Hand-Toy Contact Type	Video recordings, analysed using Alberta Infant Motor Scale (AIMS)	Not reported	Neonatology, prematurity	No procedures	Toy	Facilitated
Jannik et al. 2008, The Netherlands	CyberPsychology & Behavior	Clinical study using randomisation (pilot study)	A low-cost video game applied for training of upper extremity function in children with cerebral palsy: a pilot study	1) To determine the user satisfaction of the EyeToy for the training of the upper limb in children with cerebral palsy (CP). 2) to determine the effect of this training method on the upper limb function	12	5 vs. 5	7 to 16	1) Trying the EyeToy (play station) 2) Adding Eye Toy to their regular physiotherapy for 6 weeks (total treatment intensity was equal for both groups: 30 minutes twice a week)	Statisfaction, upper limb function	Questionnaire (purpose made), Melbourne Assessment scores	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedures	Digital media (VG)	Facilitated
Wille et al. 2009, Switzerland	Developmental Neurorehabilitation	Intervention study with no comparator group (pilot study)	Virtual reality-based paediatric interactive therapy system (PITS) for improvement of arm and hand function in children with motor impairment--a pilot study	To address a research gap by testing a child-specific, low-cost VR-based interactive therapy system in the rehabilitation of children with congenital or acquired motor deficits	5	No comparator group	11 to 15	3 sessions Paediatric interactive therapy system (PITS)over 3 weeks. Allows children to practice specific movements of the upper limbs with immediate feedback about their motor performance. 3 different games.	Performance, motivation	Melbourne Assessment (MA), the Box and Block Test (BBT) and the Nine Hole Peg Test (NHPT)	Physical therapists / occupational therapists	Neurology, motor impairment	No procedure	Digital media (VG)	Facilitated
Murphy et al. 2009, USA	International Journal of Pediatric Obesity	Clinical study using randomisation	Effects of an exercise intervention using Dance Dance Revolution on endothelial function and other risk factors in overweight children.	To determine whether an exercise intervention using an active video game (Dance Dance Revolution) is effective in improving endothelial dysfunction (EDF) and other risk factors in overweight children	35	23 vs. 12	7 to 12	12 week exercise: home-based aerobic exercise program using Dance Dance Revolution (DDR),Subjects were encouraged to use DDR 5 days per week	BMI, heart rate, EEG, BP, Flow-mediated dilation, cholesterol (HDL, LDL), triglycerides, insulin, glucose, peak ocygen uptake	Blood samples, cycle ergometer, ECG,	Not reported	Endocrinology, obesity	No procedure	Digital media (VG)	Self-directed

Heathcock & Galloway 2009, USA	Physical Therapy	Clinical study using randomisation	Exploring objects with feet advances movement in infants born preterm - a randomized controlled trial.	To determine whether preterm infants born at less than 33 weeks of gestational age contacted a toy with their feet at 2 months of corrected age, before doing so with their hands, and whether movement training advanced feet reaching.	26	13 vs. 13	preterm (born <33 weeks gestional weight < 2500 g)	20 minutes of daily movement training (preterm) vs daily social training (preterm)	Foot-toy contacts, hand-toy contact	Vidoe recordings, number of contacts with toy	Not reported	Neonatology, prematurity	No procedures	Toys	Facilitated
Berntsen et al. 2010, Norway	International Journal of Pediatric Obesity	Clinical study using randomisation	Obese children playing towards an active lifestyle	To determine whether five months of guided active play in overweight or obese children and adolescents under multi-disciplinary management for weight reduction leads to increased physical activity levels in leisure time, as well as changes in aerobic fitness and body composition.	60	36 vs. 24	7 to 17	60-minute guided active play/physical activity twice a week for 5 months (All participants received dietary advice and were encouraged to increase physical activity level)	Body mass Body composition aerobic fitness physical activity	DXA scan VO2peak during treadmill running Physical activity: ActiGraph7164	Doctors (pediatricians) Research assistants Other (instructers from School of sports sciences)	Endocrinology, obesity	No procedure	Active play	Facilitated
Fluet et al. 2010, USA	Developmental Neurorehabilitation	Intervention study with no comparator group (pilot study)	Interfacing a haptic robotic system with complex virtual environments to treat impaired upper extremity motor function in children with cerebral palsy	To investigate the ability of the New Jersey Institute of Technology Robot Assisted Virtual Rehabilitation (NJIT-RAVR) system training to elicit changes in upper extremity (UE) function in children with hemiplegia secondary to cerebral palsy	9	No comparator group	5 to 18	Subjects trained 1 hour, 3 days a week for 3 weeks. Two groups performed this protocol as their only intervention. The third group also performed 5 to 6 hours of constraint-induced movement therapy.	Upper limb function	Melbourne Assessment of Unilateral Upper Limb Function Test	Physical therapists / occupational therapists Unspecified healthcare professionals	Neurology, cerebral palsy	No procedure	Digital media (robot)	Facilitated
Adamo et al. 2010, USA	Applied Physiology, Nutrition, and Metabolism	Clinical study using randomisation	Effects of interactive video game cycling on overweight and obese adolescent health.	To test if the interactive video game cycling condition will produce greater adherence, exercise behaviour, body composition, and health outcomes compared with cycling to music.	30	Video game cycling: 15 vs. Music cycling: 15 (2 vs. 2 lost to follow up)	12 to 17	GameBike: Interactive video game cyckling condition vs stationary bike + music, both groups: exercise twice (60 min) weekly for 10 weeks	Adherence, Submaximal fitness, BMI, Aerobic fitness, Body Image, Psychosocial functioning, Diet	Number of sessions, food diary, BMI, body composition (Tanita), Cycle ergometer , Borg scale (peak heart rate, rate of percived exertion), Body Esteem Scale for Adolescents and Adults (BESSA), Harter's 35-item Self-Perceptions Profile for Adolescents (SPPA),	Doctors (endocrinologists) Psychologists	Endocrinology, obesity	No procedure	Digital media (VG)	Self-directed
Bingham et al. 2010, USA	Clinical Pediatrics	Intervention study with no comparator group with mixed methods	A breath biofeedback computer game for children with cystic fibrosis	To develop and test a breath-controlled video game using a digital spirometer that, by providing visual breath biofeedback, could promote awareness of breathing techniques in children with cystic fibrosis.	10	No comparator group	7 to 17	Breath-controlled video game using a digital spirometer (6 sessions of 15min)	Breathing technique	No specific scales were applied. Structured interviews. Spirometry	Child life specialists Researcher Nurses	Pulmonology, cystic fibrosis		Digital media (VG)	Self-directed
Bart et al. 2011, Israel	Disability and Rehabilitation	Non-randomised clinical study	Using video-capture virtual reality for children with acquired brain injury	To assess the use of a video-capture projected VR system for children with acquired brain injury, and to compare their performance to that of matched healthy controls.	33	17 vs. 16 matched healthy controls	6 to 11	3 different VR environments, 20 min, Gesture Tek's GX Interactive Rehabilitation and Exercise system	Attention Motor abillity Functional capabillity Subjective experience	Test of everyday attention for children (TEA-Ch) Melbourne assessment of unilateral upper limb function Paediatric evaluation of disability inventory: PEDI, Caregiver Assistance Scale The short feedback questionnaire for children (SFQ-Child)	Physical therapists / occupational therapists Others	Neurology, acquired brain injury	No procedure	Digital media (VR)	Facilitated

Brütsch et al. 2011, Switzerland	Journal of Rehabiltation Medicine	Non-randomised clinical study	Virtual reality for enhancement of robot-assisted gait training in children with central gait disorders.	To examine the effect of various forms of training interventions, with and without virtual reality, on the initiation and maintenance of active participation during robotassisted gait training.	24	10 vs. 14 matched healthy controls	9 to 16	All participants walked in the driven gait orthosis Lokomat® (VR) in 4 different randomly-assigned conditions.	Biofeedback values calculated during swing phases	Self-designed motivational questionnaire. Visual analogue scale (VAS) on the extent to which they had liked the different training conditions, from 0 (“not at all”) to 10 (“very much”).	Physical therapists / occupational therapists	Neurology, central gait disorders	No procedure	Digital media (VR)	Facilitated
Schmitt et al. 2011, USA	Burns	Clinical study using randomisation on within subject design	A randomized, controlled trial of immersive virtual reality analgesia, during physical therapy for pediatric burns.	To compare the effectiveness of adjunctive, immersive virtual reality with that of conventional pharmacologic treatment alone during one or more post-burn physical therapy sessionsin the inpatient setting.	54	54 (crossover)	6 to 19	SnowWorld (VR game) during physical therapy session. Subjects “throw” virtual snowballs at snowmen, igloos, mammoths and penguins by aiming with their gaze and pressing a keyboard/mouse button.	Pain, amount of fun, nausea, maximum range-of-motion	0 to 100 graphic rating scale (GRS), 3 components of pain: the cognitive component of pain, the affective component of pain, and the sensory component of pain. Amount of fun and nausea. Goniometer	Physical therapists / occupational therapists	Surgical diseases, burns	physical therapy session	Digital media (VR)	Facilitated
Wuang et al. 2011, Taiwan	Research in Developmental Disabilities	Quasi-randomised clinical study	Effectiveness of virtual reality using Wii gaming technology in children with Down syndrome.	To investigate if virtual reality using Wii gaming technology (VRWii) is efficacious in enhancing sensorimotor functions compared to standard sensorimotor training among children with DS.	160	52 VRWII (Virtual reality using Wii) / 53 SOT (standard occupational therapy) / 50 Controls	7 to 12	WiiVR and sensory integrative therapy. Each intervention group received a 1-h session 2 days per week for 24 weeks.	Motor and sensory performance	BOT-2 (Bruiniks-Oseretsky Test of Motor Proficiency-Second Edition), VMI (Visual Motor Integration), TSIF (Test of Sensory Integration Function)	Physical therapists / occupational therapists	Neurology or other, downs syndrome	No procedure	Digital media (VG)	Facilitated
Sandlund et al. 2011, Sweden	Developmental Neurorehabilitation	Intervention study with no comparator group with mixed methods (pilot study)	Using motion interactive games to promote physical activity and enhance motor performance in children with cerebral palsy.	To explore the feasibility of using low-cost commercial motion interactive games (EyeToy) as a 4-week home-based intervention for children with CP	14	No comparator group	6 to 16	Each child was provided with a Sony PlayStation and the EyeToy game Play3, which includes about 20 different games, for use at home over a 4-week period. Children were recommended to practice with the EyeToy game for at least 20 minutes/day.	Intensity and motivation for pratice, Physical actitity, Motor performance,	Physical activity monitor SenseWear Pro3 Armband (measuring Total Energy Expenditure (TEE), number of steps and time spent as ‘physically active’), The Movement Assessment Battery for Children-2 (mABC-2), gamning diary.	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Self-directed
De Kloet et al. 2012, The Netherlands	Brain Injury	Intervention study with no comparator group (pilot study)*	Gaming supports youth with acquired brain injury? A pilot study.	To explore the effect of the usage of the Nintendo Wii in children, adolescents and young adults with ABI on variables effecting body functions, activities, participation and overall quality-of-life	50	No comparator group	6 to 29	TherapWii: 12-week intervention. Two training sessions (60 min) with Nintendo Wii with trianed physical therapist or teacher from the special school.	Adherence to intervention, Physical, recreational and social activity, Cognitive/neuropsychological functioning, Achievement of individual treatment goals, Quality of Life.	Time spent on physical activity (4-point scale), CAPE (Children's Assessment of Participation and Enjoyment), ANT (Amsterdam Neuropsychologische Taken), Rating scale (1-10) to rate own performance and and activity, PedsQL	Physical therapists / occupational therapists Others (special teachers)	Neurology, acquired brain injury	No procedure	Digital media (VG)	Facilitated
Gordon et al. 2012, Jamica	Physiotherapy	Intervention study with no comparator group (pilot study)	Potential of the Nintendo Wii™ as a rehabilitation tool for children with cerebral palsy in a developing country: a pilot study.	To explore the possibility of: (1) using the Nintendo Wii for the rehabilitation of children with CP in a setting with multiple distractions; (2) children with both good and limited grasp function being able to play the selected games; and (3) both wheelchairdependent and ambulant children being able to train with the gaming system. Additional objectives were to determine: (4) the acceptability of this form of training among children with	7	No comparator group	6 to 12	Training with the Nintendo Wii was conducted twice weekly for 6 weeks. The games used were Wii Sports Boxing, Baseball and Tennis.	Acceptebility of intervention, gross motor function,	Number of sessions completed, Gross Motor Function Measure (GMFM)	Physical therapists / occupational therapists (and final year students)	Neurology, cerebral palsy	No procedure	Digital media (VG)	Facilitated

				CP; and (5) whether training with the Nintendo Wii had the potential to impact gross motor function.										
Omar et al. 2012, Egypt	Burns	Clinical study using randomisation	Influences of purposeful activity versus rote exercise on improving pain and hand function in pediatric burn.	To explore the influences of purposeful activities versus rote exercises on pain, range of motion and hand function in children with hand burn	30	15 vs. 15	8 to 14	Purposeful activities consisted of playing a game that was identified by the child as an activity that he/she enjoys doing (At the beginning of each treatment session, the child was given a choice of 5 to 7 identified play activities e.g. play in sterile water in zink or play dough)	Pain, total active motion, hand function	Faces scale and analogue scale (VAS), TAM standard dorsal hand goniometer, Jebsen-Taylor hand function test	Nurses Unspecified healthcare professionals	Surgical diseases, burns (hand)	No procedure	Purposeful play	Facilitated
Rostami et al. 2012, Iran	Neuro Rehabilitation	Clinical study using randomisation	Effects of modified constraint-induced movement therapy in virtual environment on upper-limb function in children with spastic hemiparetic cerebral palsy: A randomised controlled trial	To determine effects of implementing a practice period of modified constraint-induced movement therapy in a virtual environment on upper limb function in children with spastic hemiparetic cerebral palsy.	32	8 vs. 8 vs. 8 vs. 8 (VR, mCIMT (modified constraint-induced movement therapy), VR+mCIMT, Control)	6 to 12	The VR group received rehabilitation in the E-Link virtual environment. an individualised 18-hour VR program, occurring every other day, 3 times per week for 4 weeks. CIMT: The intervention consisted of an individualised, 18-hour program of modified CIMT occurring every other day, 3 times per week during a 4 week period	Upper limb performance, hand function	Pediatric MotorActivity Log (PMAL), Speed and Dexterity subtest (subtest 8) ofthe Bruininks to Oseretsky test of motor proficiency(BOTMP) to measure hand function	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VR)	Facilitated
Sharan et al. 2012, India	Work	Clinical study using randomisation	Virtual reality based therapy for post operative rehabilitation of children with cerebral palsy	To evaluate the effect of VRBT on balance, manual ability, level of the participation and satisfaction among the post operative children, suffering from cerebral palsy, who were going through a rehabilitation process.	16	8 vs. 8	mean 8.88±3.23 SD and 10.38±4.41 SD	Nintendo Wii Sports or Fit (3 days week for 3 weeks	Manual ability and balance	Manual Ability Classification System (MACS) for upper limb function and pediatric balance score (PBS)	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Facilitated
Andrysek et al. 2012, Canada	Arch Phys Med Rehabil	Non-randomised clinical study (pilot study)	Preliminary evaluation of a commercially available videogame system as an adjunct therapeutic intervention for improving balance among children and adolescents with lower limb amputations	To examine the safety, feasibility, and balance performance effects of a 4-week home-based balance therapy program using a commercially available videogame system.	16	6 vs. 10 matched healthy controls	8 to 18	Wii Fit videogame system from Nintendo, which uses a balance platform as the game controller on which the player stands and actively shifts his/her weight during videogame playing. Participants were asked to play to preselected Wii Fit games for 20 min per game for 4d/week for a period of 4 weeks.	Safety/ compliance and feasibility	Pre/post intervention: COP (Center of Pressure), CB&M (Community Balance & Mobility Scale. At Home: Logbook (to report frequency and duration, likes/dislikes), Midterm snd Post intervention Questionnaire (purpose made)	Physical therapists / occupational therapists Others (rehabilitation team)	Surgical diseases, lower limb amputation	No procedure	Digital media (VG)	Self-directed
Ilg et al. 2012, Germany	Neurology	Non-randomised clinical study within subject design (pilot study)	Video game-based coordinative training improves ataxia in children with degenerative ataxia.	To provide evidence that children with degenerative spinocerebellar disease can improve whole-body coordination and dynamic balance by an 8-week phase of intensive but at the same time highly motivational and playful coordination training.	10	10 (their own controls)	11 to 20	Xbox games. Training was started with a supervised laboratory-based 2-week training phase, consisting of 4 1-hour training sessions per week.	Balance, Motor performance, Ataxia symptoms	Scale for the Assessment and Rating of Ataxia (SARA score), Activity-specific Balance Confidence Scale, Inventory of Non-Ataxia Symptoms, Activity-specific Balance Confidence Scale, VICON	Physical therapists / occupational therapists	Neurology, degenerative ataxia	No procedure	Digital media (VG)	Self-directed

										MX motion capture system					
Bingham et al. 2012, USA	Respiratory Care	Clinical study using randomisation within subject design (pilot study)	Pilot trial of spirometer games for airway clearance practice in cystic fibrosis.	To test the hypothesis that games could increase subjects' engagement with forced expiratory breathing maneuvers and improve pulmonary function tests (PFTs).	13	13 (crossover)	7 to 14	Digital spirometers and computers set up as "game only" or "control" devices.	Change in lung function	Number of expiratory high flow events (HFEs), and change in PFTs	Others (respiratory therapists)	Pulmonology, cystic fibrosis	No procedure	Digital media (VG)	Facilitated
Abdulsatar et al. 2013, Canada	Journal of Pediatric Rehabilitation Medicine	Intervention study with no comparator group (pilot study)	"Wii-Hab" in critically ill children: a pilot trial.	To evaluate the safety and feasibility of virtual reality (VR) exercise as a novel acute rehabilitation intervention in a Pediatric Critical Care Unit setting.	12	No comparator group	3 to 18	10 min Nintendo Wii boxing twice a day for 2 days	Feasibility and safety Change in vital signs (HR, RR, SpO2, BP) Upper limb activity during WiiTM game Grib strength Caregiver feedback (questionnaire)	The Pediatric logistic organ dysfunction (PELOD) The Pediatric Cerebral Performance Category (PCPC) The Pediatric Overall Performance Category (POPC) scores on admission were used to quantify cognitive and functional ability of each patient at baseline	Nurses Doctors	Intensive care, various severe illnesses or injuries	No procedure	Digital media (VG)	Facilitated
Calcaterra et al. 2013, Italy	Journal of Pediatric Endocrinology & Metabolism	Intervention study with no comparator group	Improved metabolic and cardiorespiratory fitness during a recreational training program in obese children	To investigate the effect of a 12-week controlled recreational training program for sedentary obese children, also including interactive video game exercises	22	No comparator group	9 to 16	Exercise twice a week for a 12-week period. The training sessions were led by specialized exercise trainers and lasted 90 min. The exercise program consisted of a combination of circuit-based aerobic exercises, strength and resistance exercises; specifically soccer, rugby, volleyball and basketball, interactive video game exercises	Anthropometric measurements, BP, HR, VO2max, metabolic profile	Standard assessment of the physiologic/metabolic parameters	Specialized exercise trainers Pediatricians (evaluation)	Endocrinology, obesity	No procedure	Active play, digital media (VG)	Facilitated
Jelsma et al. 2013, South Africa	Developmental Neurorehabilitation	Clinical study using randomisation within subject design	The effect of the Nintendo Wii Fit on balance control and gross motor function of children with spastic hemiplegic cerebral palsy.	To study the impact of training using the Nintendo Wii Fit in 14 children with spastic hemiplegic cerebral palsy.	14	14 (their own controls)	7 to 14	Wii Fit balance board while the research assistant operated the gaming controller. The intervention sessions took place four times a week for 25 min during the children's regular physiotherapy time slots	Functional mobility, balance, gross motor function, intervention acceptibility	Bruininks to Oseretsky test of Motor Proficiency 2nd Edition (BOT-2) and the timed up and down stairs test (TUDS), Question: Which would you choose to ordinary physiotherapy or using the Nintendo in place of therapy?	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Facilitated

Olivieri et al. 2013 Italy	BioMed Research International	Intervention study with no comparator group (pilot study)	Rehabilitation of children with hemiparesis: a pilot study on the use of virtual reality	To investigate the feasibility, effectiveness, and engagement of using nonimmersive Virtual reality for upper limb rehabilitation in children with congenital hemiplegia.	6	No comparator group	4 to 16	Ten 45-minute sessions were administered to each child, once per week, as part of the ongoing rehabilitative treatment: every child received one session of traditional physiotherapy and one VR based treatment per week without increasing the number of treatments per week	Motor performance	Melbourne Assessment of Unilateral Limb Movement, Ashworth Scale, and Arm's PROM	Physical therapists / occupational therapists	Neurology, congenital hemiplegia	No procedure	Digital media (VR)	Facilitated
Peper et al. 2013, The Netherlands	Developmental Neurorehabilitation	Intervention study with no comparator group	Bimanual training for children with cerebral palsy: exploring the effects of Lissajous-based computer gaming.	To examine the potential effects of the training on bimanual coordination	6	No comparator group	7 to 12	Four computer games were designed (based on Lissajous feedback) to challenge the children to move the arms in various bimanual rhythmic coordination patterns. Three sessions (30 min each; supervised by a therapist) per week were provided, in which the child performed the computer games (next to their usual care program)	Upper extremity performance, Gaming performance	Assisting Hand Assessment, Rhythmic bimanual coordination, Unimanual aiming	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Facilitated
Tarakci et al. 2013, Turkey	Journal of physical therapy science	Intervention study with no comparator group (pilot study)	Wii-based Balance Therapy to Improve Balance Function of Children with Cerebral Palsy: A Pilot Study	To investigate the effects of Wii-based balance therapy on balance and walking function of patients with CP.	14	No comparator group	5 to 17	Wii training was performed in a standardized program, 2 times a week for 12 weeks, with sessions lasting approximately 40 minutes.	Motor function	MAS: Modified Ashworth Scale, The Gross Motor Function Classification	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Facilitated
Chen et al. 2013, Taiwan	Osteoporos Int	Clinical study using randomisation	Efficacy of home-based virtual cycling training on bone mineral density in ambulatory children with cerebral palsy	To assess the efficacy of a novel home-based virtual cycling training (hVCT) program on bone density for children with spastic CP	27	13 vs. 14	6 to 12	12 weeks home-based virtual cycling training	Bone mineral density Gross Motor Function Muscle strength	GMFM-66	Research assistents	Neurology, cerebral palsy	No procedure	Digital media (VG)	Self-directed
Winkels et al. 2013, The Netherlands	Developmental Neurorehabilitation	Intervention study with no comparator group	Wii™-habilitation of upper extremity function in children with Cerebral Palsy. An explorative study	1) To examine the effect of WiiTM training on the quality and use of upper extremity movements during the performance of mostly bimanual daily activities. 2) to evaluate the user satisfaction and usability of the WiiTM computer games for, respectively,the participants and health professionals. 3) to observe if enjoyment in gaming persisted during the period of training.	15	No comparator group	6 to 14	During six weeks, children attended training with the WiiTM home video game console Sports twice a week at the for 30 min Two physical therapists trained all children and each child was trained by the same therapist during all sessions.	Upper limb function, usersatisfaction, enjoyment	Melbourne Assessment of Upper Limb Function, ABILHAND-Kids, usersatisfaction, VAS (enjoyment)	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Self-directed
Sandlund et al. 2014, Sweden	Developmental Neurorehabilitation	Intervention study with no comparator group	Training of goal directed arm movements with motion interactive video games in children with cerebral palsy - a kinematic evaluation.	To evaluate the quality of goal-directed arm movements in 15 children with cerebral palsy (CP) following four weeks of home-based training with motion interactive video games.	15	No comparator group	6 to 16	The children were instructed to practice with the EyeToy-game for at least 20 min per day and to keep a gaming diary to document the time spent on training. 4 weeks	Movement smoothness, Movement precision, COP path, Maximal shoulder angle, Maximal shoulder angle	Spatiotemporal parameters, movement smoothness and movement precision were all assessed as distal kinematics for the movements of the hand, and were calculated from recordings of the reflexive marker on the second	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Self-directed

											metacarpophalangeal joint.					
Bingham & Calhoun 2015, USA	Games for Health Journal	Intervention study with no comparator group (pilot study)	Digital Posturography Games Correlate with Gross Motor Function in Children with Cerebral Palsy	To assess whether performance on posturography games correlates with the Gross Motor Function Measure (GMFM) in children with cerebral palsy	15	No comparator group	4 to 14	Simple games: Postural sway on movement of a ball on a screen. After 5 minutes to test the effect of their postural sway on ball movement, the children played a sequence of three games (“Standing Still,’’ “Test Your Limit,’’ and “Follow That Paddle”), for a total game session of 15 minutes	The children carried out three trials for each game, and the average of these trials was used for statistical analysis	Game performance was compared with GMFMs. Likert scales were used to obtain subjective responses to the balance games.	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Facilitated
Gomes, E. L. F. D. Carvalho, C. R. F. Peixoto-Souza, F. S. Teixeira-Carvalho, E. F.	PloS One	Clinical study using randomisation	Active Video Game Exercise Training Improves the Clinical Control of Asthma in Children: Randomized Controlled Trial	To determine whether aerobic exercise involving an active video game system improved asthma control, airway inflammation and exercise capacity in children with moderate to severe asthma.	36	20 vs. 16	5 to 11	The game “Reflex Ridge” from Kinect Adventure (XBOX 360 Kinect,) was used for training. The children then played the video game for 30 minutes vs exercise training carried out for 30 minutes starting at 70% of the maximum effort determined during the maximum exercise testing.	Physical capacity, energy expenditure, asthma control	Bruce protocol, NIOX Mino device, peak flow, Asthma Control Questionnaire, a biaxial accelerometer	Physical therapists / occupational therapists	Pulmonology, asthma	No procedure	Digital media (VG)	Facilitated
Lazarri et al. 2015, Brazil	Journal of physical therapy science	Clinical study using randomisation	Effect of a single session of transcranial direct-current stimulation combined with virtual reality training on the balance of children with cerebral palsy: a randomized, controlled, double-blind trial	To investigate the effects of a single session of tDCS (Transcranial direct current stimulation) over the primary motor cortex combined with virtual reality training on the balance of children with CP.	12	6 vs. 6	4 to 12	Mobility training with virtual reality was (Xbox kinect fitness game) performed for 20 minutes with simultaneous tDCS (active or placebo).	Sway velocity	SWAY software program	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VR)	Facilitated
Lowes et al. 2015, USA	Muscle & Nerve	Non-randomised clinical study	Reliability and validity of active-seated: An outcome in dystrophinopathy.	To establish the tool’s validity and reliability of Ability-Captured-Through-Interactive-Video-Evaluation -seated (ACTIVE-seated) which utilizes the Microsoft Kinect gaming interface	77	61 vs. 16 healthy controls	6 to 37	ACTIVE-seated (on average 3 trials of 60 sec per subject)	Mobility	Maximal UE excursion in the X (horizontal: left and right),Y (vertical: table top to overhead), and Z (depth:forward toward the camera) planes to quantify the subject’s functional reaching volume (FRV) Pediatric Evaluation ofDisability Inventory-Computerized Adaptive Test(PEDI-CAT)	Physical therapists / occupational therapists	Neurology, Dystrophinopathy	No procedure	Digital media (VG)	Facilitated

Parry et al. 2015, USA	Journal of Burn Care & Research	Clinical study using randomisation (pilot study)	A Pilot Prospective Randomized Control Trial Comparing Exercises Using Videogame Therapy to Standard Physical Therapy: 6 Months Follow-Up.	To compare planar and functional range of motion (ROM), compliance, pain, enjoyment, and exertion in pediatric burn patients receiving two types of rehabilitation therapy	17	9 vs. 8	5 to 18	Videogame therapy (VGT) vs. Standard therapy (ST) (both during a 6-month period of rehabilitation after burn injury	Range of motion (ROM)	Planar and functional ROM was measured using goniometry and motion analysis,	Physical therapists / occupational therapists	Surgical diseases, burns	No procedure	Digital media (VG)	Facilitated
Salonini et al. 2015, Italy	Respiratory Care	Clinical study using randomisation within subject design	Active Video Game Playing in Children and Adolescents With Cystic Fibrosis: Exercise or Just Fun?	To compare both the cardiovascular demand produced and perceptions of dyspnea, fatigue, and enjoyment of pediatric subjects with CF while using Xbox Kinect versus traditional stationary cycle training.	30	30 (crossover)	8 to 17	Xbox Kinect and a traditional stationary cycle.	Heart rate enjoyment dyspnea fatigue	SpO2 level of dyspnea using the visual analog scale with a happy-face pain-rating scale, and perception of fatigue using the Children's OMNI-Step Scale	Physical therapists / occupational therapists	Pulmonology, cystic fibrosis	No procedure	Digital media (VG)	Facilitated
Shin et al. 2015, South Korea	The Journal of physical therapy science	Clinical study using randomisation	Effects of conventional neurological treatment and a virtual reality training program on eye-hand coordination in children with cerebral palsy	To evaluate the effects of conventional neurological treatment and a virtual reality training program on eye-hand coordination in children with cerebral palsy	16	8 vs. 8	mean 8	The experimental group, the other eight children performed 30 minutes of therapeutic exercise and 15 minutes of a training program using virtual reality twice a week during the experimental period.	Motor development	KDTVP- 2 (Korean-Developmental Test of Visual Perception)	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VR)	Facilitated
Zoccolillo et al. 2015, Italy	European Journal of Physical and Rehabilitation Medicine	Clinical study using randomisation within subject design	Video-game based therapy performed by children with cerebral palsy: a cross-over randomized controlled trial and a cross-sectional quantitative measure of physical activity.	1) To investigate the effectiveness of VGT (video game based theraphy) with respect to conventional therapy (CT) in improving upper limb motor outcomes in a group of children with CP. 2) to quatify if the VGT leads children to perform a higher number of movements.	22	22 (crossover)	4 to 14	During VGT period they played a video game (Xbox Kinect) 30 minutes sessions, twice a week for 8 weeks	Upper limb function, hand abilities, visual motor integration	Quality of Upper Extremities Skills Test (QUEST), Abihand-Kids Score, Visual-Motor Integration functioning scale (VIM)	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Facilitated
Alsaif & Alsenany 2015, Saudi Arabia	Journal of Physical Therapy Science	Clinical study using randomisation	Effects of interactive games on motor performance in children with spastic cerebral palsy	To investigate the effect of training with Nintendo Wii Fit games on motor performance in children with spastic cerebral palsy	40	20 vs. 20	6 to 10	Group A played the Nintendo Wii Fit game for 20 minutes/day for 12 weeks, while group B did not (control group).	Motor performance test variables (e.g. e.g., goaldirected arm movements, balancing, and jumping)	The Movement Assessment Battery for Children-2 (mABC-2)	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Self-directed
Dusing et al. 2015, USA	Pediatric Physical Therapy	Clinical study using randomisation with mixed methods (pilot study)	Supporting Play Exploration and Early Development Intervention From NICU to Home	To determine the feasibility of completing a clinical trial of Supporting Play Exploration and Early Development Intervention (SPEEDI) that blends early and intense intervention with family support during the transition from the neonatal intensive care unit (NICU) to home and the community.	10	5 vs. 5	Preterms born gestational week <34	Supporting Play Exploration and Early Development Intervention (SPEEDI) vs. usual care SPEEDI included 2 intervention phases: phase 1 in the NICU from 35 weeks' PMA to 0 months' AA (or hospital discharge) and phase 2 from 0 months' AA (or hospital discharge) until 3 months' AA.	Motor performance Cognition	Neonatal Medical Index (NMI) actibvity-log guided interview using principles of phenomenology, Test of Infant Motor Performance The Bayley Scales of Infant and Toddler Development The Early Problem Solving Indicator (EPSI), the cognitive portion of the Individual Growth and Development Indicators (IGDI)	Physical therapists / occupational therapists	Neonatology, prematurity (NICU)	No procedure	Therapist and parent provided interactions and motor stimulation	Facilitated

Acar et al. 2016, Turkey	The Journal of Physical Therapy Science	Quasi-randomised clinical study	Efficacy of neurodevelopmental treatment combined with the Nintendo® Wii in patients with cerebral palsy	To investigate the efficiency of Nintendo® Wii games in addition to neurodevelopmental treatment in patients with cerebral palsy.	30	15 vs. 15	6 to 15	Two groups: neurodevelopmental treatment+Nintendo Wii group vs neurodevelopmental treatment group Treatment in both groups was applied by a physical therapist for 45 minutes per session, twice a week, for 6 weeks. The patients in group 1 played virtual reality games of tennis, baseball, and boxing (each game 5 minutes) for 15 minutes in addition to the standard neurodevelopmental treatment in each treatment session, wich was focus on the hemiplegic hand.	upper extremity functions, speed, manual ability, and level of independence in activities of daily living	Quality of Upper Extremity Skills Test, Jebsen Taylor Hand Function Test, ABILHAND-Kids test, and Pediatric Functional Independence Measure	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Facilitated
Lee et al. 2016, Mexico	The Journal of Physical Therapy Science	Intervention study with no comparator group	Using health games for rehabilitation of patients with infantile cerebral palsy	To evaluate whether the therapeutic games developed by the study team are significantly effective for upper limb rehabilitation of patients with cerebral palsy and to assess the development of the games and the evolution of patients throughout the therapy sessions.	5	No comparator group	6 to 10	Two sets of rehabilitation games were developed to stimulate the upper limb, in which patients were required to perform flexion, extension, pronation, and supination of the arm movements and hand grip, which are the fine motor skills of the arms and hands. The rehabilitation game was designed with different levels of difficulty that can be played depending on the outcome in patients. There by, patients are encouraged to improve their fine mobility.	Movements	Not reported	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Facilitated
Sabel et al. 2016, Sweden	Disability and Rehabilitation	Clinical study using randomisation on within subject design (pilot study)	Active video gaming improves body coordination in survivors of childhood brain tumours.	(1) To explore the effects of AVG on EE levels during gaming sessions as well as overall for the duration of the intervention; (2) to evaluate the compliance to the study protocol over time and to evaluate the general feasibility of the method and (3) to evaluate its effect on physical functioning, by a standardised measure of physical performance validated for children and adolescents	13	7 vs. 6 (crossover)	7 to 17	Active video gaming (Nintendo Wii) aiming for a minimum of 30 min AVG per day, at least 5 days a week, for 10 weeks, but allowing to extend the period to 12 weeks to compensate for weeks being away or ill. Weekly Internet coaching sessions were used to sustain motivation and evaluate enjoyment	Physical functioning, activity	Bruininks to Osteretsky Test of Motor Performance, activity monitor SenseWear Pro 2 Armband	Physical therapists / occupational therapists	Oncology, CNS tumour	No procedure	Digital media (VG)	Facilitated
Sajan et al. 2016, India	Developmental Neurorehabilitation	Clinical study using randomisation (pilot study)	Wii-based interactive video games as a supplement to conventional therapy for rehabilitation of children with cerebral palsy: a	To assess the effect of interactive video gaming (IVG) with Nintendo Wii (Wii) supplemented to conventional therapy in rehabilitation of children with cerebral palsy (CP)	20	10 vs. 10	5 to 20	1 session of Wii games per day vs. conventional therapy (all children participated in conventional therapy approx. 36h/week)	Postural control and balance Secondary outcome measures: Upper limb functions, Visual-perceptual	Posturography and the pediatric Berg's balance scale; upper limb functions by Box and Block Test and the Quality of Upper Extremity Skills Test (QUEST); visual-	Physical therapists / occupational therapists Nurses (rehabilitation) Psychologists Others	Neurology, cerebral palsy	No procedure	Digital media (VG)	Facilitated

			pilot, randomized controlled trial						skills Functional ambulation.	perceptual skills by Test for Visual-Perceptual Skills (TVPS) to third edition; and functional ambulation by walking distance and speed.	(speech therapists, social workers)					
Tarakci et al. 2016, Turkey	Pediatrics International	Clinical study using randomisation	Effects of Nintendo Wii-Fit® video games on balance in children with mild cerebral palsy	To compare the effects of Wii-Fit balance-based video games and conventional balance training, in addition to an individualized NDT approach, on children with CP.	30	15 vs. 15	5 to 18	Nintendo Wii Fit gaming console was used for training. 2 days per week (50 min per session) for a total of 12 weeks	Balance	Sit-To-Stand Test (STST), Functional Sideways Reach Test (FSRT), Functional Forward Reach Test (FFRT), Timed Get Up and Go Test (TGGT), 10 m walk test (10mWT), 10 Steps Climbing Test (10SCT), Functional Independence Measure for Children (Wee-FIM)	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Facilitated
Westergren et al. 2016, Norway	BMJ Open	Intervention study with no comparator group with mixed methods (pilot study)	Active play exercise intervention in children with asthma: a pilot study	To pilot a 6-week exercise intervention designed as active play and examine attendance rate, exercise intensity and children's perceptions of participating	6	No comparator group	10 to 12	Active play exercises were designed and directed by experienced sport instructors. Equipment used in the active play programme were soft balls, Swiss balls, cones, beanbags, balloons, small mats, gymnastic mats, jumping ropes, vaulting boxes, benches and 'paintball bunkers'. (60 minues x 2 week for 6 weeks).	Attendance, Anthropometrics and lung function, Cardiorespiratory fitness, Quality of life and asthma control, Physical activity	Attendance rate, BMI, VO2max, HRQoL (Paediatric Asthma Quality of Life Questionnaire, PAQLQ), Asthma Control Questionnaire (ACQ), SenseWear Pro, field observations, focus group interviews	Others (sport instructors)	Pulmonology, asthma	No procedure	Active play exercises	Facilitated
Wilcox et al. 2016, USA	Physical Therapy	Intervention study with no comparator group (pilot study)	Joint-Specific Play Controller for Upper Extremity Therapy: Feasibility Study in Children With Wrist Impairment	To understand the relationship among controller play activity, measures of wrist and forearm range of motion (ROM) and spasticity, and ratings of fun and difficulty	21	No comparator group	4 to 12	Two different toys and 2 different computer games were used with the controller during the in-clinic play session. The children played with each toy and game for approximately 5 minutes. At the start of the play session, the impaired wrist and forearm of each child (or more impaired wrist and forearm of children with bilateral impairments) was fitted with a specially designed play controllerthat wirelessly interfaces with toys and games	Active range of motion (AROM) Wrist flexion and extension motion	AROM: geometry, potentiometer	Physical therapists / occupational therapists	Neurology, neuromuscular deficits	No procedure	Digital media (VG), toy	Facilitated

Gerber et al. 2016, Switzerland	Journal of NeuroEngineering and Rehabilitation	Intervention study with no comparator group (pilot study)	Preparing a neuropediatric upper limb exergame rehabilitation system for home-use: a feasibility study.	To investigate the feasibility and usability of the new portable version of the YouGrabber® system (YouRehab AG, Zurich, Switzerland) in the home setting.	15	No comparator group	6 to 14	The portable YouGrabber system is a computer-enhanced upper limb training system (Fig. 1a). “Boxes” containing sensors were attached with Velcro to the size fit neoprene gloves. The software consists of an app called “training planner”. Children and their parents were instructed to train at least 5 times for 30 min during the first week. In the second week, they were allowed to train as much as they wanted	Device usage, user satisfaction, usability	There were questions about usability, motivation, and the general opinion (VAS format), The YouGrabber automatically records data whenever a game is running.	Physical therapists / occupational therapists	Neurology, neuromotor disorders	No procedure	Digital media (VG)	Self-directed
Preston et al. 2016, United Kingdom	Clinical Rehabilitation	Clinical study using randomisation (pilot study)*	A pilot single-blind multicentre randomized controlled trial to evaluate the potential benefits of computer-assisted arm rehabilitation gaming technology on the arm function of children with spastic cerebral palsy.	To evaluate the potential benefits of computer-assisted arm rehabilitation gaming technology on arm function of children with spastic cerebral palsy	15	8 vs. 7	5 to 12	The computer-assisted arm rehabilitation gaming technology was delivered within one week of botulinum toxin treatment and collected six weeks later. Parents were asked to encourage their children to use the gaming technology for 30 minutes a day. Half of the children used the device for three or fewer of the six weeks, with one child using the gaming technology in the first week only	Arm function	ABILHAND-kids and Canadian Occupational Performance Measure	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Self-directed
Sgandurra et al. 2016, Italy, Denmark	Research in Developmental Disabilities	Quasi-randomised clinical study (pilot study)*	A pilot study on early home-based intervention through an intelligent baby gym (CareToy) in preterm infants.	To explore the feasibility of CareToy intervention in preterm infants, aged 3 to 9 months of corrected age	20	14 vs. 6	0.25 to 0.75	The CareToy to be used at home is a smart system, inspired by baby gyms and composed by four different modules: (1) a gym module made of (i) a kit of sensorized toys with different shape and size, designed to promote different grasping abilities, (ii) two interactive walls (a feedback wall with embedded sounds and lights and a belt wall with a sensorized pillow), (iii) an arch with lights, (iv) four cameras; (2) a vision module (screen wall), equipped with a large monitor; (3) a mat module with a sensorized mat and three wearable sensors (two bracelets and chest strap) and (4) a tele-rehabilitation module that allows the communication	Infant Motor Profile, feasibility	Infant Motor Profile, Alberta Infant Motor Scale (AIMS), Teller Acuity Cards, CareToy Questionnaire Parent-infant Experience (CPQE)	Doctors (neurologists)Physical therapists / occupational therapists	Neonatology, prematurity	No procedure	Baby gym	Facilitated

							between CareToy system and the clinical centre. 4 weeks/30-45 minutes.							
Bonnechère et al. 2017, Belgium	Disability and Rehabilitation	Intervention study with no comparator group	Balance improvement after physical therapy training using specially developed serious games for cerebral palsy children: preliminary results.	To assess if a specially developed serious games (SG) could be an interesting option to motivate children to perform specific exercise for balance improvement.	10	No comparator group	5 to 15	Patients received four sessions of series games included into conventional therapy (1 session of 30 min a week during 4 weeks). All games were controlled with a Nintendo Wii Balance Board (WBB) linked to a computer via Bluetooth	Trunk control and balance	Trunk Control Motor Scale (TCMS) before and after intervention	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Facilitated
El-Shamy & Alsharif 2017, Saudi Arabia	Journal of Musculoskeletal and Neuronal Interactions	Clinical study using randomisation	Effect of virtual reality versus conventional physiotherapy on upper extremity function in children with obstetric brachial plexus injury.	To evaluate the effects of virtual reality versus conventional physiotherapy on upper extremity function in children with obstetric brachial plexus injury.	40	20 vs. 20	5 to 8	Virtual reality program vs. conventional physiotherapy program	Shoulder movements, range of motion, strength	Mallet scoring system, Shoulder range of motion (ROM), handheld dynamometer (HHD)	Physical therapists / occupational therapists	Neurology, Erb's palsy	No procedure	Digital media (VR)	Facilitated
Gatica-Rojas et al. 2017, Chile	European Journal of Physical and Rehabilitation Medicine	Clinical study using randomisation	Does Nintendo Wii Balance Board improve standing balance? A randomized controlled trial in children with cerebral palsy	To compare the effect of two therapy programs, the Nintendo Wii balance board (Wii-therapy) and standard physiotherapy (SPT), on the performance of standing balance in children and adolescents with CP.	32	16 vs. 16 (matched pairs)	7 to 14	Wii-therapy consisted of training sessions using the Wii Fit Plus with the Nintendo Wii Balance Board for 30 minutes, divided into three series18 sessions delivered at a frequency of three times per week over 6 weeks	Standing balance,	Center-of-pressure (CoP) sway (CoPSway), standard deviation in the medial-lateral (SDML) and the anterior to posterior (SDAP) directions, and velocity in both directions (VML and VAP).	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Facilitated
Lazzari et al. 2017, Brazil	Journal of Motor Behavior	Clinical study using randomisation	Effect of Transcranial Direct Current Stimulation Combined With Virtual Reality Training on Balance in Children With Cerebral Palsy: A Randomized, Controlled, Double-Blind, Clinical Trial	To investigate the effects of continuous transcranial direct current stimulation (tDCS) combined with virtual reality training on static and functional balance in children with cerebral palsy (CP)	20	10 vs. 10	5 to 9	The intervention consisted of 10 sessions (five per week for two weeks) of virtual reality mobility training combined with active or sham tDCS. Virtual reality mobility training was performed using the "Your Shape: Fitness Evolved 2012" selected for aerobic exercises on Xbox Kinect. The experimental group received active stimulation (1 mA) and the control group received active stimulation only during the first and final 30 s of mobility training.	Balance	Pediatric Balance Scale, Timed Up and Go Test, and force plate (under 4 conditions)	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VR)	Facilitated
Machado et al. 2017, Brazil	Journal of Motor Behavior	Intervention study with no comparator group	Motor Improvement Using Motion Sensing Game Devices for Cerebral Palsy Rehabilitation	To investigate the effects of an intervention based on interactive game set with the movement sensor Kinect on children with cerebral palsy (CP).	28	No comparator group	3 to 12	Playing two games from the Xbox 360 Kinect system twice a week for two months, so that each child participated in a total of 16 sessions of 40 min each.	Motor performance	Gross Motor Function Measure (GMFM)	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Facilitated

Meyns et al. 2017, Belgium	Games for Health Journal	Quasi-randomised clinical study (pilot study)	The Effect of Additional Virtual Reality Training on Balance in Children with Cerebral Palsy after Lower Limb Surgery: A Feasibility Study.	To examine the feasibility (in terms of recruitment, treatment adherence, and assessment process) and patient enjoyment of using additional VR training in a rehabilitation center for CPc after lower limb orthopedic surgery	11	4 vs. 7	5 to 18	The intervention group received the same rehabilitation as the control group, with an additional training using VR games (ICT4Rehab; Nintendo Wii balanceboard). The additional VR training was given three times a week for 30 minutes under supervision of one of the three raters or a pediatric physiotherapist specialized in CP. Patients trained until discharge.	Sitting balance, feasibility	Trunk Control Measurement Scale (TCMS) Visual Analog Scale (VAS) for enjoyment	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Facilitated
Sabel et al. 2017, Sweden	Neuro-Oncology Practice	Clinical study using randomisation within subject design (pilot study)	Effects of physically active video gaming on cognition and activities of daily living in childhood brain tumor survivors: a randomized pilot study	To explore if physically active video gaming could: i) improve cognitive functions and ii) improve the execution of activities of daily living among survivors of childhood brain tumors	13	7 vs. 6 (cross-over after 10-12 weeks)	7 to 17	Active video gaming (Nintendo Wii) aiming for a minimum of 30 min AVG per day, at least 5 days a week, for 10 weeks, but allowing to extend the period to 12 weeks to compensate for weeks being away or ill. Weekly Internet coaching sessions were used to sustain motivation and evaluate enjoyment	Cognitive function, Activities of Daily Living	Conner's continuous performance test (CPT II), Map mission, Visual scanning Delis-Kaplan executive function system (D-KEFS), Digit span (WISC-IV), Auditory consonant trigrams (ACT), Rey auditory verbal learning test (RAVLT), Spatial span (Wechsler nonverbal scale of abilities), Controlled oral word association test (COWAT), Stroop (Incongruent Colour word task). Assessment of Motor and Process Skills	Psychologists	Oncology, CNS tumour	No procedure	Digital media (VG)	Facilitated
van den Heuvel et al. 2017a, The Netherlands	International Journal of Rehabilitation Research	Intervention study with no comparator group with mixed methods (pilot study)*	Can the IROMEC robot support play in children with severe physical disabilities? A pilot study	To explore the application of the IROMEC (Interactive social RObotic Mediators as Companions) robot to support play for children with severe physical disabilities in rehabilitation and special education.	11	No comparator group	1 to 16	The intervention with the IROMEC robot started with a session to introduce the robot to the child or children and to become familiar with the robot. After this first session, five intervention sessions followed. Four different appearances for the robot were available: a pig, a car, a lion and a chameleon. A session lasted ~30 min.	Feasibility, usability, barriers for the child as well as the therapist and an indication of the effects on playfulness	The Individually Prioritized Problem Assessment (IPPA), VAS (playfulness assessment), description of feelings (like, neutral, dislike) using smileys, Qualitative interviews	Physical therapists / occupational therapists Others (physical education teacher, group teacher)	Neurology, physical disabilities	No procedure	Digital media (robot)	Facilitated
Yoo et al. 2017, South Korea	NeuroRehabilitation	Non-randomised clinical study	Augmented effects of EMG biofeedback interfaced with virtual reality on neuromuscular control and movement coordination during reaching in children with	To compare therapeutic effects of an electromyography (EMG) biofeedback augmented by virtual reality (VR) and EMG biofeedback alone on the triceps and biceps muscle activity imbalance and elbow joint movement coordination during a reaching motor task in normal children and children with spastic cerebral palsy (CP).	18	10 vs. 8 matched healthy controls	7 to 13	This VR game was designed to provide a fun and motivating experience for children to perform the elbow extension reaching movement more implicitly or subconsciously without undesirable compensatory movement patterns. The specific goal of the game was to	Muscle strenght, elbow flexion, movement coordination	PowerTrack IITM, Box and Block Test (BBT), elbow flexion and extension range of motion (ROM)	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VR)	Facilitated

								pump up the balloon as the child increased triceps muscle contraction or activity while reciprocally inhibiting the bicep muscle activity.						
Kassee et al. 2017, Canada	Journal of Pediatric Rehabilitation Medicine	Clinical study using randomisation (pilot study)	Home-based Nintendo Wii training to improve upper-limb function in children ages 7 to 12 with spastic hemiplegic cerebral palsy	To explore the differences between a more novel approach to rehabilitation, such as the Wii, to a more conventional therapy in the home environment.	6	3 vs. 3	7 to 12	Wii Sports Resort game, to be played at home. Participants were instructed to play their choice of gamesand to play the Wii using their affected (spastic) hand for at least 40 minutes each day, 5 days a week for 6 weeks (30 days)	Upper limb function, hand grip, compliance	Melbourne Assessment (MA2), and ABILHAND-Kids, and grip strength, logbook	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Self-directed
Liu 2017, China	IEEE Transactions on Neural Systems and Rehabilitation Engineering	Intervention study with no comparator group (pilot study)	Development of an EMG-ACC- Based Upper Limb Rehabilitation Training System.	To provide an surface electromyography accelerometer game-based upper limb rehabilitation system prototype for home use, which includes a wearable game controller and several games on Android designed for specific functional training.	20	No comparator group	3 to 13	3 different games for home rehabilitation	Feasibility Motivation/joy during game	Questionnaire	Researchers, Others (game producers, advised by clinician and therapist)	Neurology, cerebral palsy	No procedure	Digital media (VG)	Self-directed
Mendoza et al. 2017, USA	Pediatric Blood & Cancer	Clinical study using randomisation (pilot study)	A Fitbit and Facebook mHealth intervention for promoting physical activity among adolescent and young adult childhood cancer survivors: a pilot study	To determine feasibility of an mHealth PA intervention consisting of the Fitbit Flex, a wearable PA tracking device and its mobile phonebased app, and a Facebook group, serving as a peer-based virtual support group.	59	29 vs. 30	14 to 18	10-week intervention consisted of (1) the Fitbit Flex wearable wristband and mHealth app and (2) a Facebook group; participation in both intervention components was voluntary in order to obtain realworld feasibility. Starting in intervention week 2, research staff contacted intervention participants via telephone or text message once per week to help set a daily step goal based on mean step counts for week 1. The Facebook group was moderated by research staff, who provided intervention participants with badges for PA and participation achievements every week	Physical activity HRQL	Active physical activity, wearable, PedsQL (generic and Cancer Modules)	Researchers	Oncology, non-specified cancer survivors	No procedure	mHealth (Wearable + Facebook group)	Facilitated
Sgandurra et al. 2017, Italy, Denmark	PLOS ONE	Clinical study using randomisation*	A randomized clinical trial in preterm infants on the effects of a home-based early intervention with the 'CareToy System'	To evaluate, through a Randomized Clinical Trial (RCT) study, the effects of CareToy intervention on early motor and visual development in preterm infants.	41	19 vs. 22	0.25 to 0.5	The CareToy were used at home is a smart system, inspired by baby gyms and composed by four different modules: (1) a gym module made of (i) a kit of sensorized toys with different shape and size, designed to promote different grasping abilities, (ii) two interactive walls (a	Motor and visual development	Infant Motor Profile, Alberta Infant Motor Scale (AIMS), Teller Acuity Cards,	Doctors (neurologists) Physical therapists / occupational therapists	Neonatology, prematurity	No procedure	Baby gym	Facilitated

							feedback wall with embedded sounds and lights and a belt wall with a sensorized pillow), (iii) an arch with lights, (iv) four cameras; (2) a vision module (screen wall), equipped with a large monitor; (3) a mat module with a sensorized mat and three wearable sensors (two bracelets and chest strap) and (4) a tele-rehabilitation module that allows the communication between CareToy system and the clinical centre. 4 weeks/30-45 minutes.							
van den Heuvel et al. 2017b, The Netherlands	International Journal of Rehabilitation Research	Intervention study with no comparator group with mixed methods (pilot study)*	Robot ZORA in rehabilitation and special education for children with severe physical disabilities: a pilot study	To explore the potential of ZORA robot-based interventions in rehabilitation and special education for children with severe physical disabilities	17	No comparator group	2 to 18	The available scenarios can be divided into four different categories: movement exercises, dance exercises, robot control and cognitive exercises. A session lasted ~ 30 min, with at least 20 min effective therapy time.	Feasibility, usability, barriers for ZORA, playfulness	Individually Prioritized Problem Assessment (IPPA), VAS (playfulness), description of feelings (like, neutral, dislike) using smiley, Qualitative interviews	Physical therapists / occupational therapists Others (physical education teacher, group teacher)	Neurology, severe physical disabilities with developmental delay	No procedure	Digital media (robot)	Facilitated
Chen et al. 2018, USA	Developmental Neurorehabilitation	Non-randomised clinical study (pilot study)	Effect of feedback from a socially interactive humanoid robot on reaching kinematics in children with and without cerebral palsy: A pilot study	To examine whether children with or without cerebral palsy (CP) would follow a humanoid robot's feedback to move their arm faster when playing virtual reality (VR) games.	17	7 vs. 10 matched healthy controls	8 to 12	Virtual reality (VR) evaluation game, called Super Pop VR without and with interactive feedback from robot	Upper arm movement	%successful reaches	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VR, robot)	Facilitated
Dusing et al. 2018, USA	BMC Pediatrics	Clinical study using randomisation (pilot study)	Supporting play exploration and early developmental intervention versus usual care to enhance development outcomes during the transition from the neonatal intensive care unit to home: a pilot randomized controlled trial.	To evaluate the shortterm efficacy of SPEEDI at enhancing reaching and play based exploratory problem solving compared to infants receiving usual care.	14	7 vs.7 (5 vs. 5)	Preterm infants born <29 weeks of gestional age	2 phase intervention utilizing principles of the synactive theory of development and action perception theory to train parents to provide daily intervention to support the infant's development through environmental enrichment and active engagement vs. usual care	Reaching skill Exploratory problem-solving behaviors *Secondary outcomes:* Neuromotor control and development	Reaching skills evaluated from video-recordings Early Problem Solving Indicator (EPSI) Secondary outcomes: Test of Infant Motor Performance (TIMP) and Bayley Scales of Infant and Toddler Development, third edition (Bayley)	Physical therapists / occupational therapists	Neonatology, prematurity	No procedure	SPEEDI	Facilitated
Hernández et al. 2018, Canada	Games for Health Journal	Intervention study with no comparator	Force Resistance Training in Hand Grasp and Arm Therapy:	To design and evaluate a low-cost gaming station that supports force resistance training in pediatric arm/hand	6	No comparator group	7 to 16	The gaming station (developed through an iterative proces) was explored in a	Perceived performance and satisfaction on	Canadian Occupational Performance Measure (COPM)	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Facilitated

		group with mixed methods (pilot study)	Feasibility of a Low-Cost Videogame Controller.	grasp therapies through mainstream videogame play				12-week trial. Children could choose between four games targeting wrist extension and elbow extension.	self-identified goals, feasibility		Doctors (neurodevelopmental paediatricians)					
Heutinck et al. 2018, The Netherlands	Clinical study using randomisation	Virtual Reality Computer Gaming with Dynamic Arm Support in Boys with Duchenne Muscular Dystrophy.	To investigate the effectiveness of virtual reality computer gaming with dynamic arm support on the functional abilities of the upper limb.	16	7 vs. 9	8 to 16	The gravity-compensated 3D-training for the arms consisted of 5 sessions per week of 15 minutes during 20 weeks. Participants practiced reaching and lifting exercises with their arms by playing virtual-reality computer games (Playstation) while using dynamic arm support (Gainboy)	Upper Limb performance, Active range of motion Muscle strenght, Quality of Life,	Performance of the Upper Limb (PUL) range of motion (ROM), quantitative muscle, hand held dynamometer (HHD), ultrasound (QMUS), the Assisted 6-Minute Cycle Test (A6MCT), the Motor Function Measure - dimension 3 "Distal Motor Function" (MFM), the Abilhand-plus, the Kidscreen-52 dimension "Physical well-being" and the Global Health Question	Others (coaches)	Neurology, Duchenne muscular dystrophy	No procedure	Digital media (VG)	Facilitated
Hung et al. 2018, Taiwan	Games for Health Journal	Intervention study with no comparator group (pilot study)	Developing a Suite of Motion-Controlled Games for Upper Extremity Training in Children with Cerebral Palsy: A Proof-of-Concept Study	To examine the feasibility and possible efficacy of a suite of motion-controlled games designed for upper extremity (UE) training in children with cerebral palsy (CP) using Kinect2Scratch.	13	No comparator group	5 to 15	Three games, requiring three UE movement patterns (shoulder holding, reaching, and handclap), 24 sessions of training (30 minutes per session)	Feasibility (addressed by adherence, engagement, satisfaction, and safety) Efficacy	Pittsburgh Rehabilitation Participation Scale (engagement) 5-point Likert scales to rate the enjoyment Quality of Upper Extremities Skills Test (QUEST)19,20 to assess the change of body function Activity level was assessed by using the Box and Block Test (BBT), Melbourne Assessment 2 (MA2), and ABILHAND-kids score	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Facilitated
Lozano & Potterton 2018, South Africa	The South African journal of physiotherapy	Quasi-randomised clinical study	The use of Xbox Kinect™ in a Paediatric Burns Unit	To investigate the effect of using the Xbox Kinect™ on outcomes of children in the PBU at Chris Hani Baragwanath Academic Hospital.	66	31 vs.35	5 to 12	Standard physiotherapy management and additional Xbox Kinect™ vs. standard physiotherapy alone (Treatment sessions are between 30 and 45 min taking place at least 1 to 2 times daily (Monday to Friday)) A minimum of twice weekly Xbox Kinect™ sessions of 15 to 30 min each were conducted.	Mobility Enjoyment of physiotherapy	Active Range of Motion (AROM) - change between discharge and follow-up 1 week after Activity Scale for Kids (ASK) modified Wong-Baker FACES® enjoyment rating scale	Physical therapists / occupational therapists	Surgical diseases, burns	No procedure	Digital media (VG)	Facilitated
Pourazar et al. 2018, Iran	Developmental Neurorehabilitation	Clinical study using randomisation	Use of virtual reality intervention to improve reaction time in children with cerebral palsy: A randomized controlled trial	To investigate the training effects of Virtual Reality (VR) intervention program on reaction time in children with cerebral palsy.	30	15 vs. 15	7 to 12	Xbox kinect: Bowling and Golf. Interventions for the experimental group were twelve 25-minutes sessions, three sessions per week, in a 4-week period	Reaction time	Simple Reaction Time (SRT) and Discriminative Reaction Time (DRT) measured at baseline and 1 day after completion of VR intervention.	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Facilitated

Chiu et al. 2018, Australia	BMJ Open	Intervention study with no comparator group (pilot study)	Balance and mobility training at home using in children with cerebral palsy: a feasibility study	To investigate whether balance and mobility training at home using Wii Fit is feasible and can provide clinical benefits.	20	No comparator group	6 to 12	8 weeks of Wii Fit training in the home, three times a week.	Feasibility, strenght, walkning, balance, participation,	Number of patients enrolled and completed the study, acceptance survey, Power-Track II commander, One-Legged Stance Test, 10 m Walk Test, 6 min Walk Test, Assistance to Participation Scale	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Self-directed
Del Corral et al. 2018, Spain	Respiration	Clinical study using randomisation	Effectiveness of a Home-Based Active Video Game Programme in Young Cystic Fibrosis Patients	To assess the effectiveness of a home exercise programme using active video games (AVGs) as a training modality for children and adolescents with CF.	39	19 vs. 20	7 to 18	The 6-week home training protocol consisted of 30- to 60-min sessions, 5 days per week, using a Nintendo Wii with the game EA SPORTS ACTIVE 2. A physiotherapist provided weekly telephone check-ins.	Exercise capacity	Modified shuttle walk test (MSWT), The 6-min walk test, horizontal jump test (HJT), medicine ball throw, hand grip device, panish version of the Cystic Fibrosis Questionnaire-Revised (CFQ-R)	Physical therapists / occupational therapists	Pulmonology, cystic fibrosis	No procedure	Digital media (VG)	Self-directed
Levac et al. 2018, Canada	Physical & Occupational Therapy In Pediatrics	Non-randomised clinical study (pilot study)	Active Video Gaming for Children with Cerebral Palsy: Does a Clinic-Based Virtual Reality Component Offer an Additive Benefit? A Pilot Study.	To compare changes in gross motor skills and functional mobility between ambulatory children with cerebral palsy who underwent a 1-week clinic-based virtual reality intervention (VR) followed by a 6-week, therapist-monitored home active video gaming (AVG) program and children who completed only the 6-week home AVG program.	11	5 vs. 6	7 to 18	Interactive Rehabilitation Exercise System (IREX): VR+AVG(first week 90 min/day x 5 days per week, remaining weeks: 30 min/day x 5 days per week) vs AVG-only. (30 min/day x 5 days per week) for 6 weeks.	Gross motor function, walking capacity, satisfaction	Gross Motor Function Measure Challenge Module (GMFM-CM), Six Minute Walk Test (6MWT), participants perceptions (7 point Likert Scale)	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Self-directed
Quadrado et al. 2019, Brazil	Disability and Rehabilitation: Assistive Technology	Non-randomised clinical study	Motor learning from virtual reality to natural environments in individuals with Duchenne muscular dystrophy	To examine whether performance improvements in the virtual environment generalize to the natural environment.	64	32 vs. 32 matched healthy controls	12 to 32 (mean 18)	Coincidence timing tasks: the individual had to move his hand to either touch the target key on the keyboard or to make a hitting gesture in front of the webcam, exactly at the moment coinciding with the bottom target cube turning on. Different sounds were provided as feedback for either a hit or miss during acquisition, retention and transfer	Motor performace	Constant timing error, absolute timing error, variable timing error	Physical therapists / occupational therapists	Neurology, Duchenne muscular dystrophy	No procedure	Digital media (VG)	Facilitated
Rubin et al. 2019a, USA	Health Education Research	Quasi-randomised clinical study	An evaluation of the implementation of a parent-led, games-based physical activity intervention: the Active Play at Home quasi-randomized trial	To assess the implementation of the Active Play at Home intervention using a mixed-methods approach	107	77 (of these, 34 with PWS) vs. 30 (of these, 8 with PWS)	8 to 16	The intervention group completed four visits that were 3 to 4 h long. There were two baseline visits, a mid-intervention visit at week 12, and a post-intervention visit after week 24.The implementation (i) a hands-on training session with parents alone and then with parents and their children, (ii) providing families with a printed PA curriculum and all the equipment needed, (iii) providing support calls to parents and (iv) providing gift cards as incentives	Attrition, compliance, fidelity	Physical Activity session checklists, Attrition rates, Group-based interviews	Unspecified healthcare professionals (not reported)	Endocrinology, Prader-Willi syndrome or non-syndromal obesity	No procedure	Play ground games, digital media (VG)	Facilitated

							for completion of the sessions.							
Rubin et al. 2019b, USA	Medicine & Science in sports & exercise	Quasi-randomised clinical study	Effectiveness of a Parent-led Physical Activity Intervention in Youth with Obesity	To evaluate whether a 24-wk parent-led PA curriculum increased PA levels and motor proficiency in youth with PWS and in youth without the syndrome, but with obesity.	111	77 (of these, 34 with PWS) vs. 34 (of these, 11 with PWS)	8 to 16	The intervention group completed four visits that were 3 to 4 h long. There were two baseline visits, a mid-intervention visit at week 12, and a post-intervention visit after week 24.	Physical activity, Motor proficiency	Actigraph, Bruininks to Oseretsky Test of Motor Proficiency—Version 2 (BOT-2)	Unspecified healthcare professionals (not reported)	Endocrinology, Prader-Willi syndrome or non-syndromal obesity	No procedure	Play ground games, digital media (VG), wearable	Facilitated
Arnoni et al. 2019, Brazil	Complementary Therapies in Clinical Practice	Clinical study using randomisation	Effects of virtual reality in body oscillation and motor performance of children with cerebral palsy: a preliminary randomized controlled clinical trial	To evaluate the effects of intervention in body sway and gross motor function of children with CP using an active video game.	15	7 vs. 8	4 to 14	Active video game vs. conventional theraphy (control). Active video game 45 minutes for 8 weeks.	Body sway	Gross Motor Function Measure, Center of Pressure (CoP)	Physiothera pists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Facilitated
Tarakci et al. 2019, Turkey	Journal of Hand Therapy	Clinical study using randomisation	Leap Motion Controller to based training for upper extremity rehabilitation in children and adolescents with physical disabilities: a randomized controlled trial	To investigate the potential efficacy of an 8-week LMCBT program set as an upper extremity rehabilitation program by comparing conventional rehabilitation program in children and adolescents with physical disabilities such as JIA, CP, and BPBI.	92	42 vs. 50	5 to 17	The rehabilitation program for both groups was conducted as 1-hour sessions 3 times a week for 8 weeks. The 2 different rehabilitation programs were set up as LMCBT program (group I) and conventional rehabilitation program (group II).	Hand function	Duruoz Hand Index, Jebson Taylor Hand Function Test, nine-hole peg test, Childhood Health Assessment Questionnaire, dynamometer	Physiothera pists	Juvenile idiopathic arthritis, cerebral palsy, and brachial plexus birth injury	No procedure	Digital media (VG)	Facilitated
Dehem et al. 2019, Belgium	Neurorehabilitation	Non-randomised clinical study (pilot study)	Validation of a robot serious game assessment protocol for upper limb motor impairment in children with cerebral palsy.	To develop a robotic method to determine UL working area, UL kinematics, and UL muscle strength in healthy and CP children	69	20 vs. 49 healthy controls	6 to 12	ReaRobot: a robot that allows movements of the upper limb by the mobilisation of the hand in the horizontal plane. A screen is placed in front of the child to provide a visual feedback of the position of the end-effector and the force exerted by the child on the end-effector.	Upper limb function, feasibility	Clinical assesment for upper limb function vs robotic assessment	Physiothera pists	Neurology, cerebral palsy	No procedure	Digital media (robot)	Self-directed

Kim & Park, 2019 South Korea	European Journal of Cancer Care	Intervention study with no comparator group (pilot study)	Feasibility and benefits of a combined programme of exercise and play for paediatric cancer survivors: A pilot study.	To determine the feasibility and benefits of a combined programme of exercise and play for childhood cancer survivors on health-related quality of life (HRQOL), post-traumatic growth and physical strength levels.	6	No comparator group	11 to 13	8-week combined programme of exercise and play. Each 60-min session included warm-up (joint mobilisation), main part (exercise form of play) and cool-down (stretching).	Feasibility, Post traumatic growth, Physical strenght Quality of Life	Recruitment, retention, attendance and adverse events. Pediatric Quality of Life (PedsQL) Post- Traumatic Growth Inventory (PTIG) Physical activity promotion system (PAPS)	Researchers	Cancer survivors	No procedure	Physical activity and play	Facilitated
Booth et al. 2019. The Netherlands	Archives of Physical Medicine and Rehabilitation	Intervention study with no comparator group (pilot study)	Immediate Effects of Immersive Biofeedback on Gait in Children With Cerebral Palsy	To investigate the immediate response to avatar-based biofeedback on 3 clinically important gait parameters: step length, knee extension, and ankle power in children with cerebral palsy (CP)	22	No comparator group	6 to 16	Children visualised themselves in the third person by a simplified avatar, representing their movements in real time.	Giat function	Biofeedback trials	Physiothera pists	Neurology, cerebral palsy	No procedure	Digital media (VR)	Facilitated
Nascimento et al. 2018, Brazil	Human Movement Science	Clinical study using randomisation	Brief reaching training with "sticky mittens" in preterm infants: randomized controlled trial	To examine whether a brief reaching training with sticky mittens was effective to improve reaching behavior in newly reaching preterm infants.	24	12 vs. 12	0.4	Velcro covered toys were used to stimulate reaching: The infants wore the Velcro covered mittens on both hands during the training. The activities were repeated 6 times over 4 min or in at least 87% of this time. Infants in the control group were placed on the researcher's lap, in the same position as the experimental group, during 4 min.	Reaching enhancement, Grasping enhancement	Observation	Physiothera pists	Neonatology, prematurity	No procedure	Toys	Facilitated
Alfano et al. 2020, USA	Developmental Medicine & Child Neurology	Non-randomised clinical study (pilot study)	ACTIVE (Ability Captured Through Interactive Video Evaluation) workspace volume video game to quantify meaningful change in spinal muscular atrophy.	To evaluate the utility of Ability Captured Through Interactive Video Evaluation (ACTIVE) scaled scores to quantify meaningful change in individuals with spinal muscular atrophy (SMA) types 2 or 3 due to disease progression or treatment.	424	62 vs. 362 healthy controls	2 to 24 (mean 10)	Ability Captured Through Interactive Video Evaluation: a custom-designed video game that measures workspace volume (WSV).	Arm function	Brooke Scale Revised Upper Limb Module (RULM) Hammersmith Functional Motor Scale Expanded (HFMSE) Patient Reported Outcomes Measurement Information System (PROMIS)	Researchers, Physiothera pists	Spinal muscular atrophy	No procedure	Digital media (VG)	Facilitated
Sanchez-Lopes et al. 2020, Spain	International Journal of Environmental Research and Public Health	Clinical study using randomisation	Play as a method to reduce overweight and obesity in children: an RCT	To analyse an intervention based on play as a means of improving the body composition of children with overweight or obesity.	108	54 vs. 54	8 to 12	The intervention consisted of physical activity based on play, with four 90 min sessions per week for nine months. In parallel, twice-monthly theoretical and practical sessions of nutritional advice were given to the children and their families. The study group performed the physical activity and received the nutritional advice, while the control group received only the theoretical and practical sessions on nutrition.	Activity, body composition,	Actigraph, bioelectrical impedance	Researchers, Sports personnel	Endocrinology, obesity	No procedure	Active play	Facilitated

	Alwhaibi et al. 2020, Egypt	Physical & Occupational Therapy In Pediatrics	Clinical study using randomisation	Augmented Biofeedback Training with Physical Therapy Improves Visual-Motor Integration, Visual Perception, and Motor Coordination in Children with Spastic Hemiplegic Cerebral Palsy: a Randomised Control Trial	To investigate the efficacy of combining augmented biofeedback training and standard therapy for improving visual-motor integration (VMI), visual perception (VP), and motor coordination (MC) in children with spastic cerebral palsy (CP).	45	15 vs. 15 vs. 15	5 to 8	A) Physicla therapy program (SC) B) Augmented biofeedback C) Physical therapy program + augmented biofeedback (The total training time was 60 min per session, three times a week, for three consecutive months.)	Visual and motor integration, visual perception, motor coordination	The Beery-Buktenica Developmental Test of VMI	Physical therapists	Cerebral palsy	No procedure	Digital media (AR)	Facilitated
	El-Shamy & El.Banna 2020, Egypt	Physiotherapy theory and practice	Clinical study using randomisation	Effect of Wii training on hand function in children with hemiplegic cerebral palsy.	To investigate the effect of Wii training on hand function in children with hemiplegic cerebral palsy.	40	20 vs. 20	8 to 12	The experimental group received Wii training involving four games for 40 minutes a day, three times a week for 12 weeks plus usual care. The control group received usual care alone.	Spasticity, grip strength, hand function,	Ashworh scale, Peabody developmental motor scale, dynamometer	Physical therapists	Cerebral palsy	No procedure	Digital media (VG)	Self-directed
	MacIntosh et al. 2020, Canada, France	Plos One	Clinical study using randomisation within subject design (pilot study)*	A biofeedback-enhanced therapeutic exercise video game intervention for young people with cerebral palsy: a randomized single-case experimental design feasibility study	To assess the feasibility of a novel intervention that combines a co-created gaming technology integrating evidence-based biofeedback and solution-focused coaching (SFC) strategies to support therapy engagement and efficacy at home.	19	19 (own controls)	8 to 18	Participants practiced at home alone for 4-weeks according to their self-defined practice schedule established during the initial conversation. Once per week, the researcher visited each participant. During the 60-minute visit they: a. Recorded gameplay with a video camera and electro-goniometer b: Measured wrist extension and grip strength c. Had a 'check-in' conversation to re-evaluate the self-defined practice goals	Feasibility, Body function	Adherence, Self-Reported Experiences of Activity Settings, active wirst extension, grip strenght, gross manual dexterity	Occupational therapists, pediatricians	Cerebral palsy	No procedure	Digital media (VG)	Self-directed
Adaptation (Diversional and recreational activities)	Kaminski et al. 2002, USA	Children's Health Care	Non-randomised clinical study	Play and pets: the physical and emotional impact of child-life and pet therapy on hospitalized children	To explore: a)How do patients rate their mood before and after a single session of child-life or pet therapy; b)how do parents and caregivers perceive a child's mood prior to and following child-life and pet therapy; c) what percentage of time are positive, negative, and neutral emotions displayed during child-life and pet therapy; and d)how does child-life and pet therapy affect physiological indicators of stress, that is, heart rate and salivary cortisol?	70	40 vs. 30	5<	Child-life-therapy or pet-fascilitated therapy	Mood emotions physiological stress parameters	Child report: Reynolds Child Depression Scale Parent's report: Mood rated on a 5 point scale for each item (happy, lonely, scared, and relaxed) on a 5-point scale Videotape evaluation: a coding scheme adapted from Clark to assess the percentage of time the child displayed different types of affect, time on task, and touching, and the number of times the child initiated activities. Physiological parameters: HR, BP, saliva cortisol	Child life specialists Pet-team	Various chronic disorders, mainly hematological or oncological disorders, cystic fibrosis, diabetes, transplant, and other medical disorders	No procedures	Pet-therapy	Facilitated

Hendon & Bohon, 2008, USA	Child: Care, Health and Development	Non-randomised clinical study	Hospitalized children's mood differences during play and music therapy	To test whether children in a hospital were happier during music rather than play therapy	60	30 vs. 30	1 to 12	Play therapy (no time limit) vs. music therapy (45min-1h)	happiness	Happiness was operationally defined as the frequency of smiles during a 3 minute period (observed by a researcher).	Child life specialists Music therapists	Not specified severe, serious acute or chronic illnessess or injuries	No procedures	Play in play room/music instruments	Facilitated
Thygeson et al. 2010, USA	Journal of Pediatric Oncology Nursing	Intervention study with no comparator group with mixed methods (pilot study)	Peaceful play yoga: serenity and balance for children with cancer and their parents	(a) To explore the feasibility of a single yoga session for children and adolescents hospitalized with cancer or other blood disorders and/or their parent(s) and (b) to determine if patients and parents experience a significant decrease in anxiety as measured at baseline and at the end of a single yoga class.	16	No comparator group	7 to 18	Playfull yoga (1 session) The yoga class, held in the inpatient unit playroom, was administered by one of the researchers, a registered yoga teacher. The lights were dimmed and relaxing instrumental music played in the background. The structure of the 45-minute class was modeled after a standardized yoga class consisting of an opening seated meditation, warm-up and centering poses, standing poses, balance poses, cool down/spinal twists, and final resting pose	Anxiety, feasibility	The Spielberger State Trait Anxiety Inventory for Children (STAIC),	Nurses (oncology)	Oncology (and haematology), various cancers such as ALL, AML, solid tumours, sickle cell disease	No procedure	Playful yoga	Facilitated
Hosseinpour & Memarzadeh 2010, Iran	Eur J Pediatr Surg	Clinical study using randomisation	Use of a preoperative playroom to prepare children for surgery.	To evaluate the efficacy of a playroom next to the operating room to reduce preoperative anxiety in children.	200	100 vs. 100	Mean 3.87 ± 1.2 SD	A playroom in a preoperative waiting hall. The playroom had colored toys and cars appropriate for diff erent ages and a TV and video to show cartoons.	Anxiety	Yale Preoperative Anxiety Scale (m-YPAS).	Not reported	Surgical diseases, various surgical diseases (inguinal herniorraphy was the most common procedure)	Surgery	Play room	Self-directed
Weber 2010, Brazil	Jornal de pediatria	Clinical study using randomisation	The influence of playful activities on children's anxiety during the preoperative period at the outpatient surgical center.	To verify the influence of playful activities during the preoperative period on the anxiety of children participating in the therapeutic recreation project conducted at the outpatient surgical center of Hospital de Clínicas de Porto Alegre (HCPA), Porto Alegre, Brazil.	50	22 vs. 25	5 to 12	Playful activities: toys, books, comic books, drawing material (sheets of paper, felt tip pens, color pencils, crayons, ruler, pencils and eraser), DVDs, and a TV set in the recreation room.	Anxiety	The modified Yale Preoperative Anxiety Scale (mYPAS)	Others (TherapeutiCRecreation Service)	Surgical diseases, various elective surgical diseases	Surgery (adenoidectomy, tonsillectomy, laryngoscopy, bone marrow biopsies, lumbar puncture, intrathecal chemotherapy, catheter removal, catheter placement, colonoscopy, endoscopy, plastic surgery, and strabismus surgery)	Toys, books, drawing, TV	Self-directed
Li et al. 2011, China	Journal of clinical nursing	Non-randomised clinical study	The effectiveness of therapeutic play, using virtual reality computer games, in promoting the psychological well-being of children hospitalised with cancer	To examine the effectiveness of therapeutic play, using virtual reality computer games, in minimising anxiety and reducing depressive symptoms in Hong Kong Chinese children hospitalised with cancer.	122	52 vs. 70	8 to 16	Therapeutic play (30 min VR games daily in small groups, 5 days a week) vs. routine care	Anxiety Depressive symptoms	Chinese Version of the State Anxiety Scale for Children (CSAS-C) Center for Epidemiologic Studies Depression Scale for Children (CES-DC)	Nurses (research nurse)	Oncology, various cancers such as leukemia, lymphoma, a solid tumour	No procedure	Therapeutic play	Facilitated

Pinquart et al. 2011, Germany	Klinische Padiatrie	Clinical study using randomisation	Do clown visits improve psychological and sense of physical well-being of hospitalized pediatric patients? A randomized-controlled trial.	To test whether clown visits would be associated with an increase in psychological and perceived physical well-being of pediatric patients.	100	50 vs. 50	6 to 14	Children were visited in their sick room by 2 clowns for about 8 (SD = 3) minutes. During the intervention, the clowns used various methods for entertaining the child according to the child ' s age (e. g., gags, music, games, magic tricks, word games, etc)	Physical and psychological well-being	modified version of the KINDL-R questionnaire (child and parent)	Hospital clown Others	Various diseases, such as appendicites, factures, gastroenteritis, abdominal pain, traumatic brain injury and others	No procedure	Medical clowns	Facilitated
Potasz et al. 2013, Brazil	Scandinavian Journal of Occupational Therapy	Clinical study using randomisation	Effect of play activities on hospitalized children's stress: a randomized clinical trial.	To investigate whether children who played during a hospitalization period would be less stressed and therefore show lower levels of cortisol (LC) compared with those who did not play in the same circumstances.	53	27 vs. 26	4 to 14	Toys are stored in a proper room where children are invited to play twice a day, in the morning and in the afternoon, as soon as the nursing staff finish their routines. Toys are also taken to children's beds and remain there for the whole day.	Stress	Urinary free cortisol	Not reported	Pulmonology, non-specified respiratory diseases	No procedure	Toys	Self-directed
Al-Yateem & Rossiter 2017, United Arab Emirates	Journal for Specialists in Pediatric Nursing	Quasi-randomised clinical study	Unstructured play for anxiety in pediatric inpatient care	To examine the effects of unstructured play activities on the anxiety levels of hospitalized children.	165	84 vs. 81	4 to 7	Age-appropriate unstructured play activities using disposable games and toys (30 min twice a day with RAs on day 2 and 3) vs. usual care	Change in anxiety (baseline vs. day 2 and 3)	A translated form of the Short to StateTrait Anxiety Inventory for Children	Research assistents Nurses	Not specified	Acute medical or surgical procedures	Toys (balloons, coloring books, face painting, play dough, bubbles, and storytelling)	Facilitated
Lopes-Júnior et al. 2018, Brazil	Integrative Cancer Therapies	Non-randomised clinical study within subject design (pilot study)	The Effect of Clown Intervention on Self-Report and Biomarker Measures of Stress and Fatigue in Pediatric Osteosarcoma Inpatients: A Pilot Study	To examine the feasibility of longitudinal testing of psychophysiological parameters of stress and fatigue in pediatric osteosarcoma patients hospitalized for chemotherapy submitted to clown intervention; and to investigate whether changes in the levels of biomarkers are associated with psychological stress and fatigue levels in these patients after the clown intervention.	6	6 (their own control)	6 to 15	1 session of the clown intervention vs. no clown	Stress Fatigue	8 saliva samples over a 3-day period,The Child Stress Scale (Escala de Estresse Infantil, ESI) is derived from the Child Stress Symptoms Inventory The Pediatric Quality of Life Inventory (PedsQL)Multidimensional Fatigue Scale (MFS)	Hospital clown Nurses	Oncology, osteosarcoma	Chemotherapy	Medical clown	Facilitated
Hinic 2019, USA	Journal of Pediatric Nursing	Quasi-randomised clinical study	The Effect of a Pet Therapy and Comparison Intervention on Anxiety in Hospitalized Children	To evaluate the effect of a brief pet therapy visit and a comparison intervention on anxiety in hospitalized children	93	50 vs. 43	6 to 17	Pet therapy vs. doing a puzzle with research assistant. In both groups the research assistant interacted with the child and parent and provided brief coping skills education designed by the childlife specialist	anxiety parent satisfaction	STAIC S-Anxiety Scale (before and after visit) questionnaire	Child life specialists Research assistants Pet teams	Various diseases, inpatients hospitalized for surgery and medical conditions (acute infections, management of chronic illness, neurologic and gastrointestinal conditions).	No procedure	Pet therapy vs. laying a puzzle.	Facilitated
Biddis et al. 2019, Canada	Developmental Neurorehabilitation	Quasi-randomised clinical study	Positive Distraction in Pediatric Healthcare Waiting Spaces: Sharing Play Not Germs through Inclusive, Hands-Free Interactive Media.	To investigate the value of shared opportunities for positive distraction in pediatric healthcare environments.	271	98 vs. 82 vs. 91	5 to 19	Shared interactive media (ScreenPlay) vs passive media (a silent nature video) vs no media (standard care) in an waiting area	Activity profile, anxiety	Observation, State Trait Anxiety Inventory	Researchers	Various nerodevelopmental conditions	No procedure	Digital media (VG)	Self-directed

	Logan et al. 2019, USA	Pediatrics	Clinical study using randomisation (pilot study)	Social Robots for Hospitalized Children	To (1) describe the introduction of SR technology into the pediatric inpatient setting through an innovative partnership among a pediatric teaching hospital, robotics development, and computational behavioral science laboratories and (2) present feasibility and acceptability data.	54	18 vs. 17 vs. 19	3 to 10	(1) interactive SR teddy bear; (2) tablet-based avatar version of the bear; or (3) plush teddy bear with human presence.	Feasibility/acceptability, distress, anxiety, pain	Interviews, Compliance rates Facial affective scale, Positive and Negative Affect Scales for Children (PANAS-C), State-Trait Anxiety Inventory for Children (STAIC) Faces Pain Rating Scale Revised NRS, electrodermal activity (EDA) Video recordings	Medical doctors, Child Life Specialists, Psychologists, Nurses	Various oncological and other diseases	No procedure	Digital media (robot, teddy bear), teddy bear	Self-directed
	Lopes-Junior et al. 2020, Brazil	Cancer Nursing	Non-randomised clinical study within subject desing	Clown Intervention on Psychological Stress and Fatigue in Pediatric Patients With Cancer Undergoing Chemotherapy	To evaluate the effect of a clown intervention on the levels of psychological stress and cancer-related fatigue in pediatric patients with cancer undergoing chemotherapy	16		6 to 14	Clown intervention was performed by undergraduate and graduate students from The Laugh Company. Children, accompanied by their parents, interacted simultaneously with 2 clown volunteers in the pediatric oncology ward for approximately 30 minutes.	Stress, Fatigue	Child Stress Scale, Salivary cortisole + α-AMYLASE, PedsQL Multidimensional Fatigue	Hospital clown	Oncology	No procedure	Medical clown	Facilitated
	Tennant et al. 2020, Australia	Journal of Pediatric Oncology Nursing	Intervention study with no comparator group with mixed methods (pilot study)	Feasibility, Acceptability, and Clinical Implementation of an Immersive Virtual Reality Intervention to Address Psychological Well-Being in Children and Adolescents With Cancer	To examine multiple key user perspectives on the acceptability and feasibility of an Immersive VR therapeutic intervention for use with hospitalized patients with cancer. and to identify issues and opportunities related to the adoption and clinical implementation of VR in pediatric oncology settings.	61	No comparator group	7 to 19	Immersive VR experiences were provided. Participants viewed one of three virtual simulation experiences. Head movements allowed for interaction within a 270° field of view and corresponding soundscape, designed to account for patients receiving VR intervention while resting in bed.	Acceptability, Enjoyment, Cotent preferences	"enjoyment themometer", Child Simulator Sickness Questionnaire, Purposemade evaluation w. openended questions	Nurses, social, other uspecified healthcare professionals	Oncology	No procedure	Digital media (VR)	Self-directed
Adaptation (Coping with hospitalisation and living with disease or sequelae)	Barrera et al. 2002, Canada	Psycho-Oncology	Intervention study with no comparator group (pilot study)	The effects of interactive music therapy on hospitalized children with cancer: a pilot study	To explore the effectiveness of interactivemusic therapy in reducing anxiety and increasing the comfort of hospitalized children with cancer	65	No comparator group	0 to 18	Interactive music therapy, 1-3 sessions of 15-45 min (different types of engagement, depending on age: e.g. pre-schoolers and toddlers were engaged typically by animated playsongs, rhymes, and playing instruments)	Children's ratings of mood, parental ratings of the child's play performance, and satisfaction questionnaires completed by parents, children and staff.	The faces pain scale Play performance scale The Satisfaction Questionnaires, developed by the authors for children (CSQ,2 items) and parents (PSQ, 5 items) after a music therapy session, and for staff (SSQ, 6 items) at the end of the study enrolment (4 months)	Nurses Others (music therapists)	Oncology, various cancers such as leukemias and other malignancies (i.e. brain tumors, lymphoma, osteogenic sarcoma, Ewing's sarcoma, and neuroblastoma)	Access to a central line, taking medication, blood work, lying down following lumbar puncture, or dressing change.	Interactive music therapy	Facilitated
	Jones et al. 2002, USA	International Journal of Play Therapy	Clinical study using randomisation with mixed methods	The efficacy of intensive individual play therapy for chronically ill children	To examine the effectiveness of play therapy for children diagnosed with insulin-dependent diabetes mellitus (IDDM). Specifically effectiveness in: (a) reducing symptoms of anxiety in children with IDDM, (b) reducing the overall behavior difficulties in children with IDDM, (c) increasing healthy adjustment in children with IDDM, (d) increasing diabetic's children's adherence to their diabetic regime, and (e) having an impact on these	28	13 vs. 15	7 to 11	12 sessions of 30 minutes during a 3 week summer camp. The playrooms had materials related to the medical issues faced by diabetic children, including a fully equipped play doctor's kit, syringes, and blood glucose monitoring equipment.	Anxiety	RCMAS are divided into three subscales including Physiological Anxiety, Worry /Oversensitivity, and Social Concerns/ Concentration Observations Filial Problems Checklist Adaptation Scale-Parent Form, Diabetes	Child life specialists	Endocrinology, Type 1 diabetes mellitus	No procedures	Medical play	Facilitated

				emotional and behavioral symptoms over time.					Adaptation Scale-Child Form (DAS-Child Form).					
Barrera & Schulte 2009, Canada	Journal of Pediatric Psychology	Non-randomised clinical study within subject design (pilot study)	A group social skills intervention program for survivors of childhood brain tumors	To evaluate the feasibility and preliminary outcomes of a social skills group intervention program for child brain tumor survivors.	32	32 (their own controls)	8 to 18	8 x 2-hr weekly sessions, including role play, focused on social skills incl. frinedship making and assertion.	Feasibility, Social skills, quality of life, behavior, depression	SSRS (Social Skills Rating System, PedsQL (Pediatric Quality of Life) Cancer Module, CBCL (Child Behavior Checklist), CDI (Child Depression Inventory)	Psychologists	Oncology, brain tumour survivors	No procedures	Group intervention including role-play	Facilitated
Van Der Stege et al. 2010, The Netherlands	Patient education and counseling	Intervention study with no comparator group (pilot study)*	Using the new board game SeCZ TaLK to stimulate the communication on sexual health for adolescents with chronic conditions	To evaluate the feasibility and appreciation of this newly developed board game called SeCZ TaLK; both in youth with chronic conditions and in professionals from different health care settings/schools for the disabled. SeCZ is a Dutch acronym for Sexuality and Chronic Conditions.	85	No comparator group	12 to 25	Board game: SeCZ TaLK: a newly developed educational board game that addresses a broad range of issues surrounding sexual health issues and uses questions and communicative tasks	appreciation of the game	Youth SeCZ TaLKEvaluation Questionnaire and the Appreciation Scale. The Professional SeCZ TaLK Evaluation Questionnaire (for 12 included health staff)	Nurses Physical therapists / occupational therapistsPsychologist Others (teacher, social worker)	Not specified, chronic diseases or disabilities (outpatients)	No procedure	Board game	Facilitated
Goldfield et al. 2012, Canada	Journal of Pediatric Psychology	Clinical study using randomisation	The Effects of Aerobic Exercise on Psychosocial Functioning of Adolescents Who Are Overweight or Obese	To evaluate effects of stationary cycling to music versus interactive video game cycling on psychosocial functioning in obese adolescents	30	15 vs. 15	12 to 17	GameBike: Interactive video game cyckling condition vs stationary bike + music, both groups: exercise twice (60 min) weekly for 10 weeks	Submaximal fitness, BMI, Aerobic fitness, Body Image, Psychosocial functioning	Pre/post intervention: BMI, body composition (Tanita), Cycle ergometer , Borg scale (peak heart rate, rate of percived exertion), Body Esteem Scale for Adolescents and Adults (BESSA), Harter's 35-item Self-Perceptions Profile for Adolescents (SPPA),	Doctors (endocrinologists) Psychologists	Endocrinology, overweight/obesity	No procedure	Video game, music	Facilitated
Li et al. 2016, China	BMC Pediatrics	Quasi-randomised clinical study with mixed methods*	Play interventions to reduce anxiety and negative emotions in hospitalized children.	To test the effectiveness of play interventions to reduce anxiety and negative emotions in hospitalized children.	304	154 vs. 150	3 to 12	Participants received hospital play interventions, conducted by hospital play specialists.	Anxiety, negative emotions	VAS (pain), Chinese version of the State Anxiety Scale for Children (CSAS-C), Children's Emotional Manifestation Scale (CEMS),	Play spcialists	Not specified	No procedure	Theraputic play	Facilitated
da Silva et al. 2017, Brazil	Revista Brasileira de Enfermagem	Clinical study using randomisation (pilot study)*	Influence of Therapeutic Play on the anxiety of hospitalized school-age children: Clinical trial.	To evaluate the effects of Dramatic Therapeutic Play (DTP) technique on the degree of anxiety in hospitalized schoolage children	28	14 vs. 14	6 to 11	The children in the intervention group participated in a Dramatic Therapeutic Play session applied by the researchers.	Anxiety	Child Drawing: Hospital	Nurses	Not specified	Needle related	Dramatic Therapeutic Play	Facilitated
Platschek et al. 2017, Germany	Clinical Journal of Oncology Nursing	Intervention study with no comparator group	Computer-Based Exercise Program: Effects of a 12-week intervention on mood and fatigue in pediatric patients with cancer	To determine the benefits of a 12-week computer-based exercise intervention on perceived physical, motivational, and fatigue syndrome and psychological state.	9	No comparator group	8 to 14	12-week of supervised computerbased exercise sessions	Mood fatigue	Age-related modified paper-and-pencil MoodMeter® questionnaire directly before and after the exercise intervention at weeks 4, 8, and 12. PedsQL™ Multidimensional Fatigue Scale at baseline and at weeks 6 and 12.	Others (sports scientist = an exercise professional)	Oncology, non-specified cancer	No procedure	Digital media (VG)	Facilitated

Teksoz et al. 2017, Turkey	Journal for Specialists in Pediatric Nursing	Non-randomised clinical study with mixed methods	The impact of a creative play intervention on satisfaction with nursing care: A mixed-methods study	To investigate the impact of a creative play intervention on service-care satisfaction measurements of children and their parents.	30	15 vs. 15	8 to 12	Creative play: Using the unused clean medical materials to make toys either in playroom or bedside	Satisfaction	Patients' Nursing Care Satisfaction Tool (PNCST), PedsQL Health Care Satisfaction Tool (PedsQL)	Nurses	Not specified	No procedure	Medical play	Facilitated
Barrera et al. 2018, Canada	Psycho-Oncology	Clinical study using randomisation	A randomized control intervention trial to improve social skills and quality of life in pediatric brain tumor survivors	To determine if the social skills intervention program (SSKIP) was associated with improved self-reported, proxy-reported, and teacher-reported social competence when compared to a placebo group. The secondary objective was to determine if SSKIP was associated with improved self-reported and proxyreported QOL.	91	43 vs. 48	8 to 16	Social skills training (eg, cooperation, assertion, using social cognitive problem solving strategies, role playing, games, and arts and crafts) in 8 weekly 2-hour sessions, or an attention placebo control (games and arts and crafts only	Social competence, Quality of life	Social Skills Rating System (SSRS) (self-reported, proxy-reported (caregiver), and teacher-reported), Pediatric Quality of Life (PedsQL)	Teachers	Oncology, brain tumours	No procedure	Social skills training	Facilitated
Lowenstein et al. 2018, USA	Clinical Pediatrics	Intervention study with no comparator group	Child Life Services in an Epilepsy Monitoring Unit	To determine the value of a certified child life specialist (CCLS) on the patient and staff experiences in an epilepsy monitoring unit (EMU)	39	No comparator group	0.7 to 17	Child life intervention: preparation, procedural support, visit thoughout the stay (1-7 days)	Satisfaction Anxiety Stress	Purposemade	Child Life Specialists	Epilepsi	Epilepsy monitoring / hospital stay	Child Life intervention	Facilitated
Bettini et al. 2019, Italy	Supportive Care in Cancer	Non-randomised clinical study (pilot study)	Acceptability and feasibility of a therapeutic board game for children and adolescents with cancer: the Italian version of Shop Talk.	To assess the patients' perception of the acceptability and feasibility of the use of Shop Talk in the Italian context, and to measure any possible influences of the game on their affectivity	30	22 vs. 6 vs. 2	7 to 18	Board game (Shop Talk) played with a research psychologist vs. played with caregiver vs. played with other patients (psychologist as facilitator).	Affectivity, feasibility	PANAS-C	Psychologist	Oncology, various cancers (sarcoma, lymphoma, leukemia, neuroblastoma, osteosarcoma, yolk sac tumor)	No procedure	Board game	Facilitated
de Jong et al. 2020, The Netherlands	Clinical Child Psychology and Psychiatry	Intervention study with no comparator group (pilot study)	Coping with paediatric illness: Child's play? Exploring the effectiveness of a play- and sports-based cognitive behavioural programme for children with chronic health conditions.	To help to assess vulnerabilities among paediatric patients and support the future research and tailoring of play- and sports-based approaches to prevent a detrimental developmental outcome in children with medical conditions.	13	No comparator group	8 to 12	'Dit ben ik' consists of eight weekly 90-minute sessions. It is a cognitive behavioural group programme based mainly on sports and play activities	Behaviour, Quality of Life, Self-perception, motor competence, play behaviour	Child Behavior Checklist (CBCL), KIDSCREEN questionnaire, Self-Perception Profile for Children (SPPC), Canadian Agility and Movement Skill Assessment (CAMSA), video recordings	Health psychologist and psychomotor therapist	Mixed chronic conditions (syndroms, defiencies, transplants etc.)	No procedure	Active play	Facilitated
Flujas-Contreras et al. 2020, Spain	Computers, Informatics, Nursing	Clinical study using randomisation (pilot study)	Promoting Emotional Well-being in Hospitalized Children and Adolescents With Virtual Reality: usability and Acceptability of a Randomized Controlled Tria	To describe and compare preliminary data on the usability and acceptability of a randomized controlled trial, comparing face-to-face treatment and a VR treatment for children and adolescents hospitalized for long-term physical conditions.	19	9 vs. 10	8 to 16	Patients were randomized to a first treatment condition group (T1), given face-to-face behavioral cognitive treatment, or a second treatment condition group (T2), given a VR treatment. The VR treatment is made up of five modules framed in a space academy metaphor, during which the participant carries out various missions and progresses within a range.	Feasibility, acceptability	Usability and Acceptability Questionnaire,	Therapists	Various specified medical or surgical diseases (various cancers, nephrotic syndrome)	No procedure	Digital media (VR)	Self-directed

*Multi-center study. Abbreviations: VG: Video game, AR: Augmented reality

Supplemental Table 3. Characteristics of included qualitative studies (n=17), the different colours represent the different clinical contexts

Clinical context, role of play	Study identification	Journal	Title	Aim	Participants (ages)	Number of participants	Intervention	Theoretical framework applied in intervention	Data collection method	Data analysis	Professions involved	Disease category	Procedure	Type of play	Self-directed vs. Facilitated
Procedures and diagnostics (Distraction)	Winskill & Andrews 2008, Australia	Australasian Emergency Nursing Journal	Minimizing the 'ouch' - A strategy to minimize pain, fear and anxiety in children presenting to the emergency department	To discuss the role of distraction in reducing pain and anxiety during medical procedures and examinations for children	Not applicable	13	Distraction boxes placed in emergency departments. Distraction box is a box of toys: a tool kit for nurses and doctors to assist them in minimizing the pain and anxiety a child may experience when undergoing medical examinations or procedures	Not applied	Telephone interview based on questionnaire (evaluation) purpose made. 5 items	Not reported	Not reported	Not specified	Medical examinations or procedure	Distraction boxes	Self-directed
	Kristensen et al. 2019, Denmark	Journal of Pediatric Nursing	"WE do it together!" An Ethnographic Study of the Alliance Between Child and Hospital Clown During Venipunctures	To explore children's pain experience and their ability to cope during a venipuncture while interacting with a clown in the acute admission unit.	4 to 15	38	Verbal and non-verbal interaction with medical clown (play, music, applying temporary tattoos and humor)	Focused ethnography	Observations Informal interviews Videotapes	Thematic analysis	Researchers Nurses Medical clowns	Not specified	Venipuncture	Hospital clown	Facilitated
	Kristensen et al. 2019, Denmark	Paediatric & Neonatal Pain	An ongoing WE: A focused ethnographic study of the relationship between child and hospital clown during recurrent pain-related procedures and conditions.	To explore child-clown interactions during recurrent hospitalizations, comprising repeated painful procedures and conditions.	4 to 14	13	Clown interactions during recurrent pain-related procedures and conditions	Focused ethnography	Observations, informal interviews	Thematic approach and unfolded as a dynamic process including five phases.	Nurses, Medical Clowns	Oncology (n=12) and arthritis (n=1) (various oncologies: kidney tumor, brain tumor, leukemia, neuroblastoma, non-Hodgkin lymphoma, Erwig's sarcoma)	Recurrent pain-related procedures and conditions (e.gvenipunctu re, intramuscular injections, port-a-catheter access, nasogastric tubes, mobilization)	Hospital clown	Facilitated
	Easterlin et al. 2020, USA	Maternal and Child Health Journal	Child and Parent Perspectives on the Acceptability of Virtual Reality to Mitigate Medical Trauma in an Infusion Center	To explore pediatric patient and guardian views regarding the acceptability of using VR during procedures to mitigate medical trauma.	8 to 18	18	NB: Not an actual intervention, but a theoretical one proposed to parents and healthcare professionals. VR during infusion procedure	Not applied	Semi-structured interviews	3-step approach to: (1) identify themes; (2) develop a codebook and code transcripts using the constant comparative method; and (3) describe themes/patterns.	Physician	Gastroenterological, Inflammatory bowel disease	Infusion	Digital media (VR)	Self-directed
Patient education (Knowledge, skills, and attitudes on disease and treatment)	Pélicand et al. 2006, France	Patient education and counseling	A therapeutic education programme for diabetic children: recreational, creative methods, and use of puppets.	1. To evaluate the children's general level of satisfaction after each educational workshop and after completion of the programme; 2. to evaluate in how far the programme enabled the children to develop or reinforce the various treatment related skills that had been defined as the general objectives of the programme; 3. to evaluate the specific impact of the use of puppets on the development of a transversal psychosocial skill, which was defined as the ability of children	10 to 11	14	Group A expressed themselves through improvised puppet shows on real or fictive situations, whereas the children in Group B expressed themselves in group discussions on situations they had experienced in real life (during a diabetes summer camp with different workshops)	Winnicott ++	Video recording, semi-structured interviews. "At the end of each workshop, the children were asked to choose out of three faces (one smiling, one neutral, one hostile), At the end of the programme, a semi-guided individual interview took place. A recreational self evaluation	Content analysis	Not reported	Endocrinology, Type 1 Diabetes Mellitus	No procedure	Therapeutic educative programme Puppets	Facilitated

				to express themselves on everyday-life difficulties, emotions and attitudes related to diabetes.					tool was created for the programme. A general expression score for each child before receiving intervention"						
	Sparapani et al. 2017, Brazil	Journal of School Health	Children With Type 1 Diabetes Mellitus - Self-Management Experiences in School	To analyze the experiences of children with T1DM in self-managing the disease at school.	7 to 12	19	Puppets as a way of expressing feelings	Not applied	Interviews using puppets	Content analysis	Not reported	Endocrinology, type 1 diabetes mellitus	No procedure	Puppets	Facilitated
Treatment (Rehabilitation and exercise)	Sandlund et al. 2012, Sweden	Disability and Rehabilitation	Motion interactive video games in home training for children with cerebral palsy: parents' perceptions	To explore parents' perceptions of using low-cost motion interactive video games as home training for their children with mild/moderate cerebral palsy	6 to 16.	19	Home training program for children with CP. The game platform used was EyeToy, Play3 for PlayStation2. The children were requested to play for at least 20 minutes a day throughout a period of four weeks.	Self-determination theory (SDT) is mentioned, but not applied	Semi-structured interviews	Content analysis	Physical therapists / occupational therapists	Neurology, cerebral palsy	No procedure	Digital media (VG)	Self-directed
	Tobar & Lencina 2017, Argentina	Archivos argentinos de pediatria	The "Learning Through Play" project. Importance of interdisciplinary work among children born prematurely and their family groups in an area of high socio-environmental risk.	To enable parents to find their own tools based on their personal playing experience and, through such experience, encourage and favor interaction with their children based on a strengthened bond and their work with values (multiple module model)	0.75 to 2	32	Five workhops for parents with a child born premature. The workshops included handcrafting, role-playing, and a play, exposing personal situations and providing advice to family members. They took home a significant material souvenir created in each event and committed to try and apply what they had experienced in the workshop.	Not applied	Observations, questionnaire, TADI test	Not reported	Not reported	Neonatology, prematurity	No procedure	Developmental play	Facilitated
Adaptation (Diversional and recreational activities)	Pedro et al. 2007, Brazil	Revista Latino-Americana de Enfermagem	Playing in the waiting room of an infant outpatient clinic from the perspective of children and their companions	To understand the experience of playing for children and their companions in an outpatient waiting room.	7<	12	Free play with students in waiting area	Not applied	Semi-structured interviews	Not reported	Others (students)	Not specified, outpatient care	No procedure	Free play with students	Self-directed
	Fereday & Dabyshire 2008, Australia	Neonatal, Paediatric and Child Health Nursing	Making the wait easier: evaluating the role of supervised play in a surgical admission area	To evaluate the perceived advantages and/or disadvantages of organised and often directly supervised play from the perspectives of the parents and children waiting for surgery and the staff who work in the area	Not reported	Not applicable	A play coordinator is employed within DOSA (day of surgery admission suites), to provide a range of play, occupation and diversion activities for children. Age appropriate activities supervised by a play coordinator. (Arts and crafts, board games, video games, videos and toys).	"theoretical framework of consumer participation and involvement" and "practice development". Rapid appraisal	Face-to-face interviews with parents (n=17), telephone interviews (n=6), a written questionnaire (n=20), and interviews with children (n=9)	Content analysis, thematic analysis	Play specialists / child life specialists	Surgical diseases, not specified	Elective surgery, disease/injury not specified	Play coordinator	Facilitated
	Bastos Depianti et al. 2018, Brazil	Anna Nery School Journal of Nursing	Playing to continue being a child and freeing itself from the confinement of the hospitalization under precaution	To understand the meaning of playing for the hospitalized child under precaution	5 to 10	8	Playful activities created with the child	Not applied	Semi-structured interviews mediated by story-drawing with theme	Symbolic Interactionism	Nurses	Not specified	Children in a private precautionary room	Toy library	Facilitated
Adaptation (Coping with hospitalisation and living with disease or sequelae)	Wikström 2006, Sweden	Pediatric nursing	Communicating via expressive arts: the natural medium of self-expression for hospitalized children	To investigate what occurs during play theraphy when children were given the oppotunity to use expressive art materials such as clay, paint and/or textile, and the meaning	6 to 9	22	Visiting the play theraphy unit for expressive art activities	Non-directed approach to play (not defined) Winnicott?	Notes kept by play therapists	Not reported	Play specialists / child life specialists	Not specified	No procedure	Play therapy	Facilitated

			children put into their art objects.											
Cantrell et al. 2010, USA	Journal of Pediatric Oncology Nursing	The Role of E-Mentorship in a Virtual World for Youth Transplant Recipients	To answer the question: "What makes a successful E-mentorship model in virtual worlds for children with serious illnesses?"	Not reported	8	E-mentoring in virtual worlds, daily interactions, biweekly curricular activities by instructing participants through the synchronous chat box located within the virtual world and visible to all participants.	E-mentorship(theory not defined)	No specific scales were applied. "E-mentoring patterns such as time spent online, chat analysis, initiation of conversation, initiation of activities, and out-of-world contact"	Systematic procedures of Walcott (1994)	Others (facilitators, also called E-mentors, were trained in a mentorship model as well as in the psychosocial needs of youth who have received a transplant)	Surgical diseases, transplant receivers	No procedure	E-mentorship	Facilitated
Knutz et al. 2015, Denmark	Health Communication	Why Health Care Needs Design Research: Broadening the Perspective on Communication in Pediatric Care Through Play	To investigate whether game design can be used as a method of gathering information about the emotional state of pediatric patients, based on the imaginary experiences of emotions that children express through play.	4 to 6	24	Development and preliminary testing of a Child Patient game, gathering information about the emotinal state of the pediatric patient	Emotion theory, narrative theory, research-through-design approach	Observations, rating of child's emotional state (fictional and real)	Comparative analysis	Not reported	Not specified	Venipuncture	Digital media (VG)	Facilitated
Caleffi et al. 2016, Brazil	Revista Gaúcha de Enfermagem	Contribution of structured therapeutic play in a nursing care model for hospitalised children.	To analyse how therapeutic play structured in a nursing care model contributes to the care of hospitalised children.	4 to 12	7	Therapeutic and dramatic play sessions and/or instructional play sessions based on the stages "Welcoming/Playing/Concluding" of the nursing model Care with Play	Not applied	Interviews and observations	Convergent-care	Nurses Researchers	Various diseases, such as asthma, pneumonia, tonsilitis and gastroenteritis	No procedure	Therapeutic play	Facilitated
Witt et al. 2019, Germany	Journal of pediatric nursing	Exploring the Potential of a Pretend Play Intervention in Young Patients With Leukemia	1) To gain knowledge of parents' and professionals' perceptions about cancerstricken children's resources, burdens, and ability to pretend play. 2) to prepare the initiation of a pretend play intervention based on children's needs and included parents' and professionals' feedback.	1 to 13	13	NB: Not an actual intervention, but a theoretical one proposed to parents and healthcare professionals. Structured storytelling using toys with a moderator.	Not applied	Structured interview with parents and health-professionals	Content analysis	Nurses Doctors Others (social education workers, pedagogues music therapists) Psychologists	Oncology, Leukemia	No procedure	Pretend play	Facilitated
Gaggiotti et al. 2019, Italy	Tumori Journal	"What shall I do when I grow up?" Adolescents with cancer on the Youth Project in Milan play with their imagination and photography.	To describe a project revolving around the question "What shall I do when I grow up?"	15 to 26 years (mean 18)	27	Writing a letter to Father Christmas and a photo shoot based on the question "What shall I do when I grow up?"	Not applied	Written letters	Not reported	Unspecified health professionals, Photographer, Fashion designer	Oncology (various)	No procedure	Writing letter to Father Christmas and a playful photo shoot	Facilitated